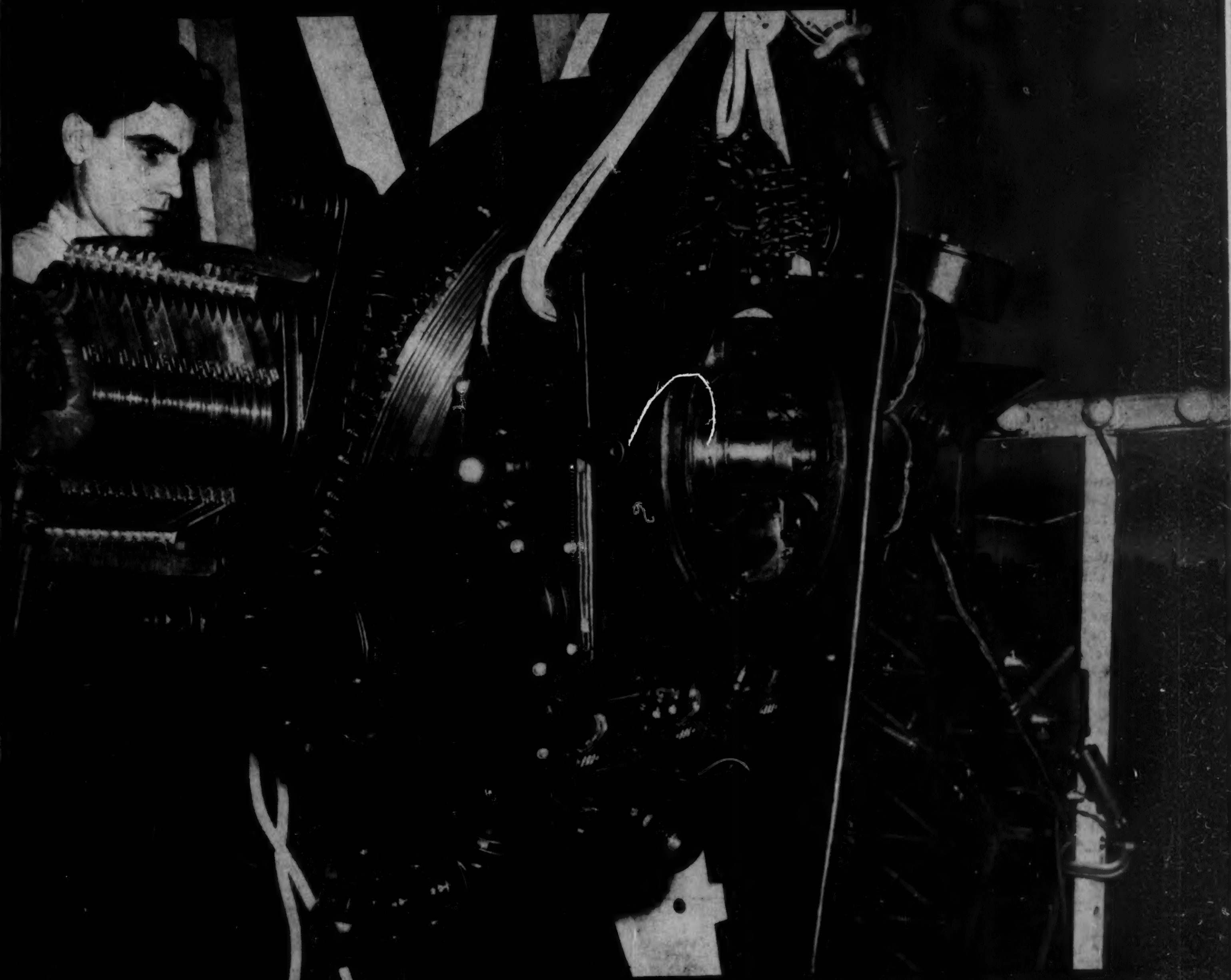

nomical Highlights

and Southern Star Char

The Great Comet of 1948

PALOMAR OBSERVATORY, November 10, 1948: Photograph of new comet taken at 5:48 a.m. Pacific daylight time, November 10th, with 18-inch Schmidt camera at Palomar Observatory. Exposure time was five minutes. Photo was taken by Dr. Albert G. Wilson, Caltech astrophysicist and member of Mt. Wilson and Palomar Observatories staff, and Dr. J. C. Duncan, Wellesley College, visiting member of Mt. Wilson and Palomar staff. Position of comet at time of picture was $13^h\ 4^m\ 54^s$, $-23°\ 14'$. Comet is moving south and west in the sky. If comet is moving away from sun, as appears to be true, it will probably become fainter. Distance from the sun and actual direction it is moving with respect to sun will not be known until its orbit is computed. Comet is visible to naked eye from elevated positions and away from city lights in Southern California. Comet is in constellation of Hydra, south of first magnitude star Spica and very close to third magnitude star Gamma Hydrae. Planets Mercury and Venus are just north of comet. Tail of comet is about 25 degrees long and brightness of head is about same as second magnitude star. First magnitude stars are brightest stars. Comet is brightest seen in Northern Hemisphere since 1927 when Skjellerup's comet was visible. Comet will appear at horizon in east at 5:45 a.m. PDT.

WITH the above release from Palomar there was distributed to the world by Associated Press wirephoto for dissemination by newspaper and television the picture of Comet 1948 l shown here. Nearly 11 months to the day after the discovery in the Southern Hemisphere of Comet 1947n, astronomers below the equator were treated to another brilliant comet. Probably first seen in Australia on November 6th, it was reported to Harvard first by Dr. J. S. Paraskevopoulos, of Harvard's southern station at Bloemfontein, South Africa, but it may have so many co-discoverers it will simply come to be known as the Great Comet of 1948. Like its recent predecessor, it became visible only after passing perihelion, but the Northern Hemisphere was fortunate in that the comet was much more favorably placed and most observers in the southern United States had a good view of it.

Early reports on the comet reached the Harvard clearinghouse from Mexico, Argentina, South Africa, and New Zealand. In the United States, it was photographed at Palomar and Flagstaff observatories on November 10th, and at Troy, N. Y., the following morning. Most observers in northern states had difficulty finding the comet, for which the following positions were predicted at the time of our going to press: Nov. 18.0, $12^h\ 04^m.4$ $-28°\ 40'$; 22.0, $11^h\ 30^m.9$, $-31°\ 4'$; 26.0, $10^h\ 56^m.1$, $-32°\ 57'$.

Parabolic elements of the comet's orbit computed by Hirst and Stoy, Cape Observatory, and independently by A. D. Maxwell, Howard University, place perihelion passage at about October 27.5, 1948, at a distance from the sun of 0.13 astronomical units. The orbital inclination is about 22.8 degrees, longitude of perihelion 106°, longitude of ascending node 209°.7.

Sky and TELESCOPE

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CHARLES A. FEDERER, JR., *Editor*; HELEN S. FEDERER, *Managing Editor*

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CONTENTS

COVER: The central portion of the Zeiss projector of the Fels Planetarium, Philadelphia, Pa. Anthony Jenzano, planetarium technician, is controlling the operation of lowering the motors and gear box out of the central main bearing. Franklin Institute photograph by J. J. Barton. (See page 31.)

BACK COVER: The diffuse nebula NGC 2024 in Orion, photographed by the 100-inch telescope on December 8, 1920. This nebula is east of the 2nd-magnitude star Zeta Orionis, and the star's large overexposed image is along the upper left edge of the picture. Mount Wilson photograph. (See In Focus.)

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Left: In the chamber of the Fels Planetarium, carpenters build the scaffold and derrick assembly preparatory to the dismantling of the projector. Right: One of the star balls and its attached planet cage are being lowered on the lift truck. All photographs in this article are by J. J. Barton, courtesy of the Franklin Institute.

DISMANTLING A ZEISS PLANETARIUM

By Roy K. Marshall, *Fels Planetarium, Franklin Institute*

AT THE CONCLUSION of a special school demonstration in the Fels Planetarium on Tuesday, October 26th, the Zeiss projection instrument froze tight in its central bearing, so that the diurnal motion of the stars westward across the sky could not be reproduced. Because it therefore has been necessary, for the first time in America, to dismantle one of the great Zeiss instruments, some account of the trouble and of the steps taken to correct it may be in order.

The failure of the planetarium was preceded by certain warnings. For example, it had been increasingly difficult to keep the contacts for carrying electrical power from one part of the machine to another in proper contact with the commutator rings. When correctly set for one position of the central mass, the sliding contacts rode too high or dipped too deeply in some other portions of one turn of the instrument. During a demonstration, a clicking or snapping noise could be heard at one or more positions of the projector, which occurred as the sliding contacts slid to the top of the commutator rings, then snapped back into position. Short circuits took place on two occasions, as a contact touched a wrong commutator.

Attempts were made to isolate the cause of this trouble, but not until October 25th, the day before the failure, was any fundamental structural misbehavior noted. First, a lag of two or three seconds occurred between the starting of the diurnal motion motor and actual motion of the instrument. When the cover plates were removed from the central boxes holding the motors and differentials, the large worm-and-gear mechanism furnishing the diurnal motion drive was exposed.

The worm wheel is attached to a motionless portion of the central mass, while the worm itself is housed in a casting attached to the inside of the central box. When the motor operates, the worm rotates and walks around the stationary wheel, causing the whole dumbbell-shaped portion of the instrument to turn around in a central polar-axis ball bearing, thereby simulating the diurnal motion. With the cover plates off, the operation of this worm and gear could be watched, and it was obvious that something was wrong, for the worm strained away from the gear. In doing so, it caused the central box to spring so as to pull the sliding contact members away from the commutator rings.

Without further evidence of any deeper-seated trouble, the diagnosis was that the castings and plates holding the worm in position had loosened, and they were readjusted to keep the worm in closer mesh with the gear. But on the following morning, just as the school children's demonstration ended, the central mass froze, and only the friction shaft and sleeve arrangement from the diurnal motion motor to the worm prevented serious damage to gears and castings.

When the worm was disengaged from the gear by dismounting the castings, and no force that could be applied by hand would produce any motion in either direction around the polar axis, only one course seemed possible. Even if the bearing could be freed by force, the cause of the failure would not be known unless the bearing and its surroundings could be examined. Only a brief consultation with Dr. I. M. Levitt, assistant director of the Fels Planetarium, and Anthony Jenzano, the technician, sufficed to make it definite that the planetarium demonstrations would be canceled until further notice, while the instrument was dismantled, the trouble determined and corrected, and the whole machine put back together.

Because of the extensive shop facilities maintained by the Franklin Institute, it was possible to call upon three carpenters at once, to build scaffolding around one end of the main dumbbell assembly, while a large gantry or frame for a hoist was erected over the other end. More than one full day was required for these preparations, and during this time some of the engineers of the staff of the Franklin Institute Laboratories for Research and Development agreed with the shop foreman and with the planetarium staff that the only proper solution of the problem was to dismantle the projector.

By removing each star ball and its adjoining planet-cage assembly as a single unit, there would be a minimum of delay in getting the instrument back together. A block and fall with three pulleys was used to lower one of these units to a wooden cradle shaped to support it. The cradle sat on the forks of a lift truck and, after the assembly (weighing several hundred pounds) was

safely down, the truck carried it to one side of the chamber and set it on the floor.

The scaffold and platform came up to within two feet of the bottom of the other star ball, and a cradle on a dolly was put beneath this ball and planet-cage assembly. The block and fall lowered the assembly into the cradle, and the whole thing rolled on the dolly to the edge of the platform. There the forks of the lift truck picked it up and lowered it to be carried to the side of the chamber.

Next, the plate on one end of the precession axis was removed. This had been press-fitted on the shaft, then locked on by a nut. A bolt through the side of this circular nut locked the nut to the plate, and two set screws locked this bolt in the nut. The manufacturer didn't want this plate to come off!

At this stage of the operation, it should be made clear that the dismantling was proceeding into the large assembly that had come from Germany as a single unit, weighing 3,200 pounds. This assembly was penetrated successfully by removing the plate and the motor box on one side, then turning the central yoke horizontal and letting the crossed precession and polar axes down through the yoke.

After two days of dismantling, the daily-motion bearing was thus exposed. Just before the axis was let down out of the bearing, the frozen motion freed itself, unaccountably. A careful turning of this ball bearing, while an ear was laid against the adjacent metal, indicated that no unusual grating or grinding noises were being produced, and it seemed likely that a replacement of the bearing would not be necessary.

When it was pulled from its sleeve, however, and the thick grease cleaned from it, the bearing showed signs of extensive damage. The outer race, consisting of two separate rings, was scored all along the line of contact of the balls with the race. The inner race was similarly scored, and there was one badly spalled spot over which the balls would bump each time one of them passed it. The balls themselves, 110 in number, five eighths of an inch in diameter, were all damaged so badly that they were distributed as souvenirs.

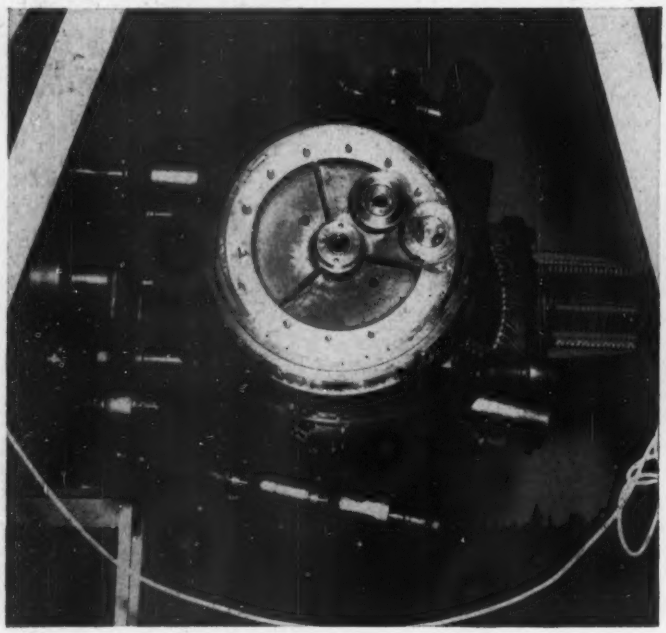
Charles Schroth and Anthony Jenzano examine the damaged bearing. Resting on the scaffold is the assembly shown on the front cover, which was let down through the bearing. Note the precession axis attached at 23½ degrees to the polar axis.

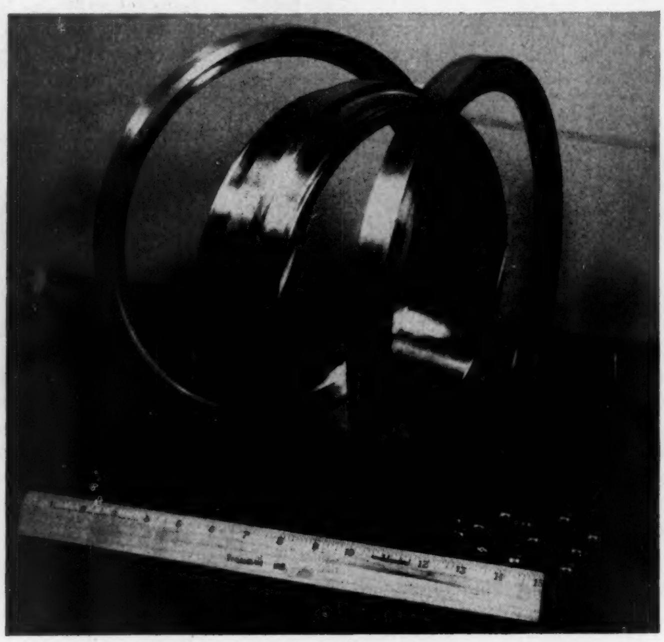
The SKF Industries in Philadelphia sent an expert to examine this large bearing, 12¼ inches outside diameter, with a 9½-inch hole for the polar axis. It seemed doubtful to him that any of the bearing could be salvaged, but when it was taken to the laboratory and examined critically by metallurgists, the decision was to regrind the double inner race and to make the two outer races from new forgings. New balls, possibly slightly oversize, would also be provided. A two-week deadline was set for the completion of this work.

The parts of the instrument were carefully stowed away, outside the chamber, and the central frame was rolled to one side of the room and covered with tarpaulins, preparatory to the repainting of the dome and refinishing of the cork floor. This renovation, originally planned for early next year, could now be done while the instrument was out of service. If all of the groups of workers involved should succeed in dovetailing their efforts, the Fels Planetarium could be open for business again on November 26th.

Now that the bearing and its mounting have been examined, the failure is not considered too puzzling. The design which made the failure possible is, however, rather surprising. In the first place, the distance between the two rows of balls in the bearing is only 1 5/8 inches, and this is the width of the fulcrum upon which is balanced a weight of almost a ton, stretching for about 10 feet from end to end. If the bearing had consisted of two distinct components, separated by six to eight inches, or even a foot, the stability of the whole assembly would have been much greater.

There is no separator to keep the two outer races from squeezing together slightly, perhaps on one side more than on the other, to produce a wedging ef-





Left: The central mass of the planetarium projector. It was into this factory-sealed part of the instrument that the dismantling penetrated for the first time in America. Right: The double inner race and two outer races of the main bearing, which proved to be considerably damaged after 15 years of operation.

fect to pinch the bearing. The depth of the space in which the bearing nestles is greater than the depth of the bearing itself, permitting separation of the outer races and displacement of the balls from their proper tracks. If any bearing needs rigid locking into one shape and position, surely it is this one which supports the assembly of greatest mass and of greatest importance in the operation of a successful planetarium demonstration.

The proper spacers will be provided by SKF, when the bearing is reassembled with a dummy load to simulate the work it has to do. It is unlikely, then, that the difficulty will recur inside the next 15 years — the life of the original bearing — particularly if extreme care is taken to obtain and to preserve the best possible balance of the moving portions of the instrument.

A neutral position for the gear-reduction drive around the polar axis is provided, and once a week or oftener, as the planetarium is serviced, this neutral position will be sought and the instrument swung by hand. This will give a constant check on the operation of the bearing, and will permit rolling the balls in their races so that recurrent patterns will be less likely. With a knowledge of what to look for in the way of symptoms of this trouble in the future, a repetition either here or at one of the other American planetarium installations is unlikely, unless a bearing is already about to fail, before the symptoms described here are detected. It may well be, of course, that the unconventional design is capable of operating successfully, after all, but that material failure or bad assembly at the factory produced an unusual situation in the instrument of the Fels Planetarium.

After the first dismay, there has been a feeling of intense interest and even pleasure at this opportunity to dig down into the vitals of the Zeiss projector. We have learned much from the experience and we believe we shall have improved the operation of the instrument, now that the opportunity has come to reach almost every part to do a thorough cleaning and realignment job.

TERMINOLOGY TALKS -- J. Hugh Pruett

The Great Comet of 1882

This splendid comet was likely the most spectacular of any during the past 100 years. Not long ago I talked to several persons in my vicinity who remembered it well.

A large, attractive painting of this wonderful object was presented to me four years ago by Mrs. Cora M. Andrews, who shortly before she reached her 84th birthday had copied this from a painting she made in her younger days. The celestial visitor was a vivid part of her memory of those predawn skies, above the trees and fences and buildings of the snow-covered farmlands in northwestern Iowa.

This comet was "officially" discovered in the daytime on September 11, 1882. Although it was then very near the sun, its brilliance made it distinctly visible. On the 17th during a few hours time it crossed the solar disk, remained a short while on the eastern side, then passed behind the sun to reappear on the western side.

During this daytime perihelion dash at 300 miles a second the comet almost grazed the sun's surface — it came within 300,000 miles of it — and started its trip back into space. The next morning it rose shortly before the sun; during the following week it was visible in daylight. But the real grandeur of this magnificent object became evident by late October when it was so far separated from the sun as to be seen in the dark eastern sky before dawn. The filmy tail, widening as it streamed back from the starlike head, extended over a long arc of the heavens.

Captain Lee Roy Woods, of Eugene, Ore., now in his 84th year and still very active in mind and body, says this of the comet:

"I was then a senior in high school. The comet was a striking object when it finally got into the night sky. The tail, surely 45 degrees or more long, started very narrow at the comet's head, but had so fanned out by the time the 'tail of the tail' was reached that it was very wide. I recall coming home from literary society one night and noticing that my hand held at arm's length just covered the width of the end of the tail." (A dime held at arm's length more than covers the full moon.)

Mrs. Anna E. Richards put her impressions of the comet in this letter:

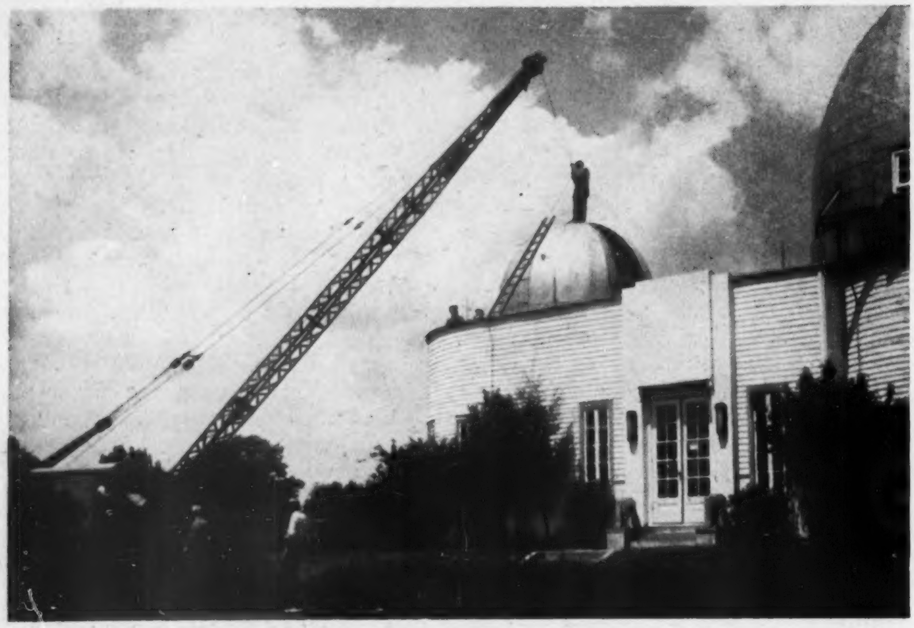
"I have for 75 years been intensely interested in the night skies. I have observed from the mountains, the desert, the deep woods and even from the ocean. I have witnessed many unusual phenomena, but the glorious comet of the early '80's was by far the greatest of all.

"My impressions are those of a little child, but very clear and vivid. The first appearance of the comet was in the early fall, and it was visible all the following winter. There were no radios, and very few newspapers, but when I heard people talking about something new in the sky I was all interest. I looked for it daily, but it was some time before I could locate the comet because the brilliant Colorado sunshine kept it dim at first. But finally its splendor filled the dark night sky.

"We were high in the Rockies west of Denver. Our view was entirely unobstructed in that clear atmosphere. My work took me back and forth each night and morning while it was dark. When the deep snows of winter covered the earth, with the cliffs and evergreen trees to break the expanse of white, it was then the comet shone brightest. Its length seemed to reach over one fourth of the sky.

"The comet was visible so long that we began to regard it as a permanent fixture. As the days grew longer I forgot the comet for a time. When I remembered it I scanned the sky, but in vain. It was gone."

A photographic copy of a painting by Mrs. Andrews, who saw the Great Comet of 1882.



Seldom does an event such as this transpire at an astronomical observatory. Here the smaller dome of the Goethe Link Observatory is being removed to the site pictured on page 36. All photographs with this article are from the Indiana University News Bureau.

Recent Developments at the Goethe Link Observatory

BY FRANK K. EDMONDSON, *Indiana University*

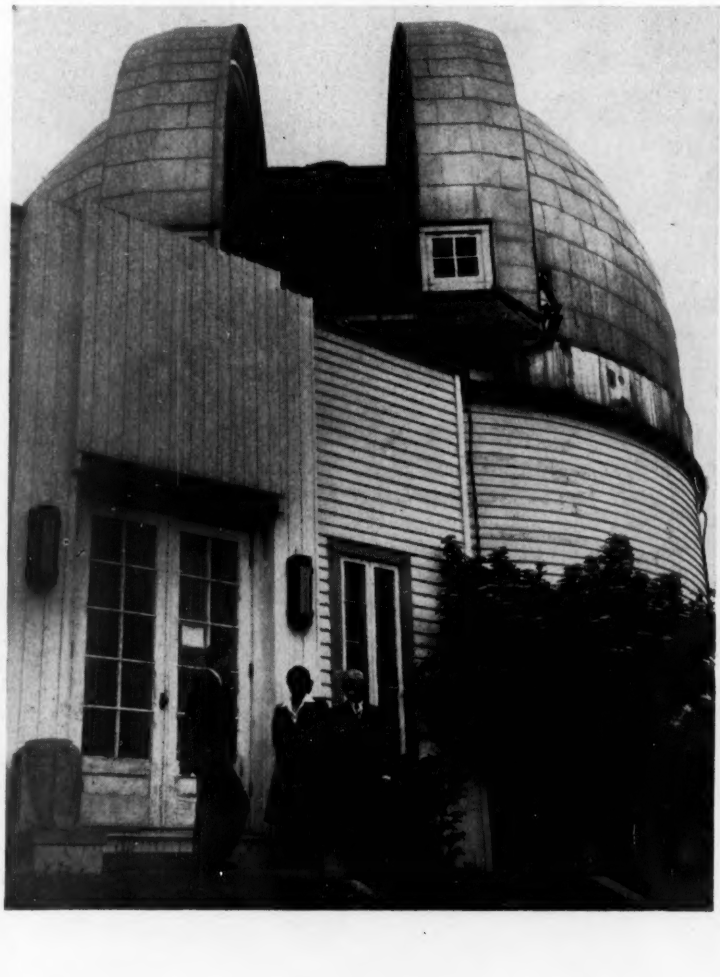
A SMALL GROUP of workmen and scientists stood on a hillside in southern Indiana watching a huge crane work into position alongside a large double-domed building. With a whir of machinery, the crane lifted up into the air, a cable was hooked onto the smaller dome, and then a workman signaled: "Lift away." Slowly the small dome was hoisted off the roof and deposited on the ground near the building. After a shorter hitch was taken, the crane trundled the small dome about 50 yards farther south and placed it on a new foundation, which had been completed only a few days earlier.

Thus began a period of major reconstruction and expansion at the Goethe Link Observatory, coinciding with the recently announced gift of the observatory to Indiana University (*Sky and Telescope,* September, 1948, page 271). The usefulness of the 36-inch reflector is to be increased by the addition of photoelectric and spectrographic equipment, partly provided for by grants from the Research Corporation, and a modern electronic drive is to be installed. A new building and mounting for the Cincinnati 10-inch Cooke lens (*Sky and Telescope,* April, 1948, page 146) are nearly finished. Repainting and refinishing of the main building are under way inside and out, and the dome-turning gear and observing elevator have been overhauled.

The 5-inch Zeiss refractor was originally in a small dome on the roof directly over the lecture room. The weight was carried on a steel I-beam which was supported by the walls of the building, and a removable jack-pole gave added rigidity when needed. This would have been satisfactory, except that it proved to be impossible to keep the roof free from leaks. It was finally decided to have the small dome moved to a new location, and a level spot was picked a short distance south of the main building. Here a concrete base and steel track were prepared by Charles C. Cook, and on April 24th the dome was moved, in the manner already described and shown by the accompanying pictures.

After the small dome was taken off, Mr. Cook started his workmen on the reconstruction of the roof of the main building, and made preparations for the building for the 10-inch. The latter is to be a sliding-roof structure, and is based on the plans for a similar building at the Leander McCormick Observatory of the University of Virginia. The Fecker mounting is likewise to be a near duplicate of the one at Virginia.

The beginning of the Goethe Link Observatory can be traced back to a series of lectures on astronomy given at the Indianapolis Extension Center by



Conversing at the entrance to the Goethe Link Observatory are Dr. Edmondson, who is now director of the observatory, Mrs. Link and Dr. Link. The top of the 36-inch reflector is visible in the open slit of the dome.

Professor K. P. Williams, of the Indiana University mathematics department, for this was the occasion of Dr. Link's first interest. In the same year Dr. Link made a trip west, and visited the Lowell Observatory armed with a letter of introduction to three former Indiana University students, V. M. Slipher, E. C. Slipher, and C. O. Lampland. The visit to Flagstaff did more than merely increase Dr. Link's interest in the subject of astronomy. It also gave him the example of an observatory built and endowed by a single individual, and this led directly to the construction and endowment of the Link Observatory. The endowment is now coming to Indiana University with the observatory, and provides sufficient income to take care of ordinary maintenance and operation costs, plus occasional additions to the equipment.

The observatory, about 35 miles northwest of the Indiana campus in Bloomington, is located on 12 acres of hilly, wooded land in Morgan County, and is about 300 feet higher than the White River valley to the east. The valley is broad, about 30 miles, and there is a fine distant view. Chosen originally because Dr. Link owned a country home on adjoining property, this site is probably the best in the entire state for an astronomical observatory.

The building was based on a sketch given to Dr. Link by Russell W. Porter, and was constructed by Charles Bowers, an Indianapolis carpenter. Amateur astronomer Victor Maier exercised general supervision over the entire project. The pier, which weighs 200 tons and extends 30 feet above ground level, was made first and then the building was put up around it. The structure is of heavy frame construction, with an interior finish of knotty-pine walls and hardwood floors. It houses the 36-inch reflector, and also has a lecture room which seats 150 persons, a darkroom, and an observer's room complete with facilities for preparing midnight lunches.

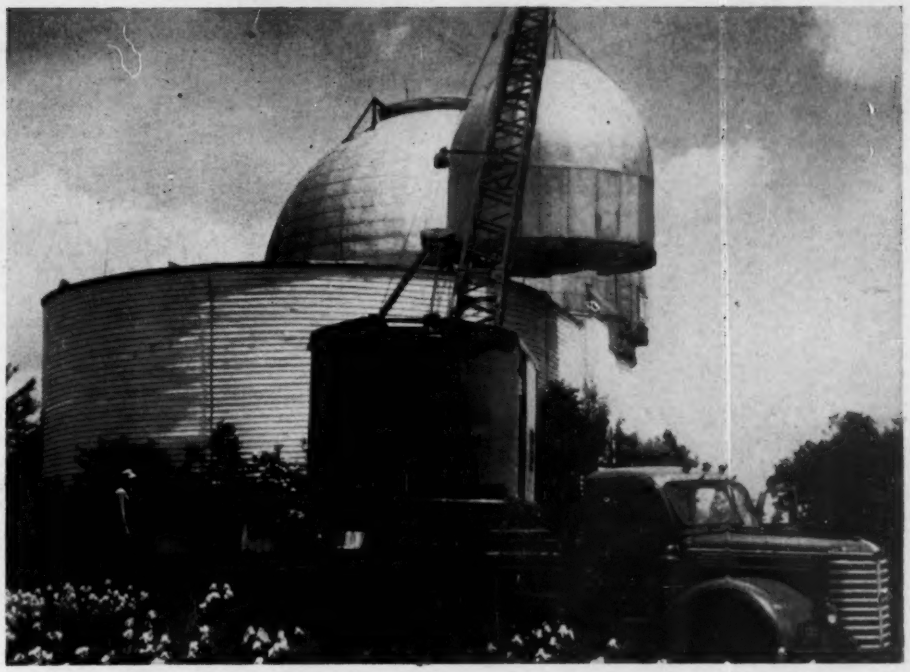
The main dome is 34 feet in diameter, and the shutter opening is eight feet across and extends four feet past the zenith. Made of wood covered with steel plate, the moving weight of the dome is 34 tons. The shutters weigh one ton each, and are opened by pushing a button.

The observing platform was based on the same principle as the one at the Steward Observatory. The elevator is pulled up a straight track, which is welded to a long arch that spans the dome. The platform is of wood, and has recently been widened in preparation for using a new prime-focus spectrograph. Plans are being made to replace it with a welded steel structure in the near future.

Construction of the Link Observatory, started in 1937, was a combination of professional and amateur efforts. An Indianapolis engineer, Carl D. Turner, was responsible for the design and construction of the mounting, which was fabricated in the Klaisler machine shop in Indianapolis. The telescope cannot be unclamped, and there are electric motor fast motions in both co-ordinates for setting. A magnetic clutch disconnects the sidereal driving motor and engages a high-speed motor for setting the hour angle. The tube is made of an aluminum alloy called Lynite, and the upper section rotates, allowing plateholder or eyepiece to be placed in any convenient position. The moving weight is 5,200 pounds, of which 2,000 pounds is contributed by the counterweight.

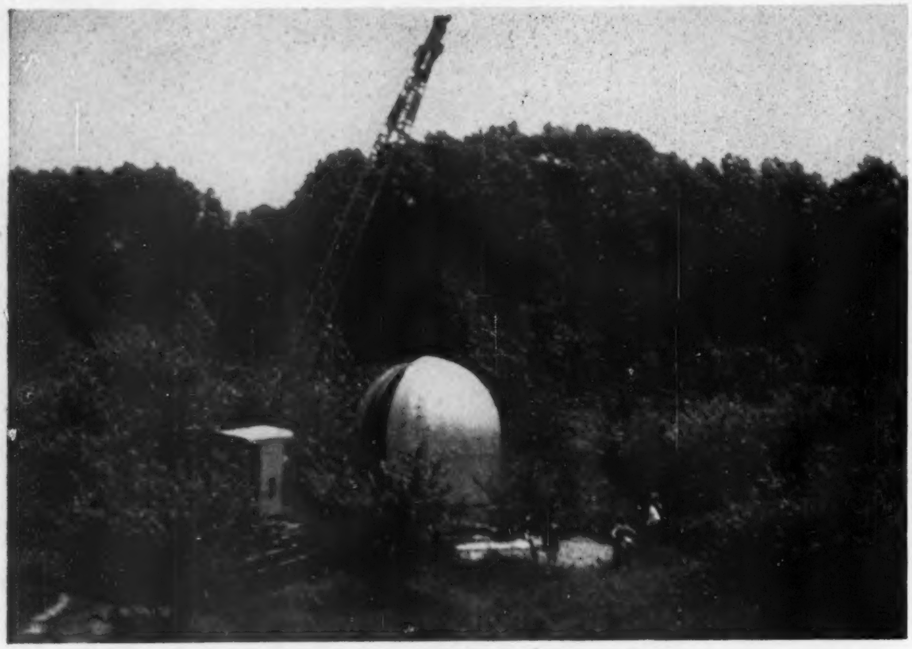
Mr. Turner also designed and built the grinding machine for the 36-inch mirror, which is a ribbed pyrex disk cast at about the same time as the 200-inch. Grinding, polishing, and figuring were in the hands of the two Indianapolis amateurs, Mr. Maier and Charles Herman. Professor W. A. Cogshall, of Indiana University, gave advice and help whenever needed, and Dr. James Cuffey arrived in time to run the photographic Hartmann tests.

The first celestial photograph was taken by Dr. Cuffey in August, 1939. With the active help of President Herman B Wells arrangements had been made in 1938, before construction was completed, for Indiana University to use the Link Observatory. To start this program, Dr. Cuffey joined the uni-



The dome of the 5-inch refractor hangs in mid-air as it is lifted off the roof.

Preparation of the base upon which the 5-inch dome was later placed. Dr. James Cuffey, of the Goethe Link Observatory staff, watches the progress of work on the cement floor.



The derrick is here depositing the dome of the refractor at its new site. Note that there is no observatory "building," as the dome furnishes its own sides.

versity staff early in 1939 as a post-doctoral research fellow. His work was interrupted in June of 1941 by a call to active duty in the navy. He served in the navigation department at Annapolis for five years, and returned to Indiana University in 1946 as an assistant professor.

The primary activity of the Goethe Link Observatory has been and will continue to be research. Public education, however, has not been neglected. From the very beginning the observatory was open to the public from time to time. Regularly scheduled public nights in charge of the Indiana University staff were started in 1946 at Dr. Link's request, and these will be continued. The present arrangement is to have the observatory open to the public on four Sunday nights in the fall and four in the spring. A short lecture is given by a faculty member or a graduate student, in addition to observation with the 36-inch reflector. Attendance at these public nights has run as high as 110. The new location for the 5-inch Zeiss refractor will make it more useful on public nights.

Except for the period of gasoline rationing, students in the elementary astronomy class at Indiana University have been taken on a field trip to the Link Observatory each semester. The postwar enrollment of over 150 in this course has turned these trips into a major operation. The entire class can be taken care of in four nights with the aid of a chartered school bus and a few private cars.

The research program thus far has been devoted almost entirely to Dr. Cuffey's work on the photographic photometry of star clusters, using a double-slide plateholder at the prime focus of the 36-inch. A photoelectric photometer was built last year by J. Lynn Smith as a master's thesis, and Dr. Cuffey plans to use this for setting up more accurate sequences for the determination of magnitudes in star clusters. Additional photoelectric equipment is being developed by Dr. John B. Irwin, aided by a grant from the Research Corporation.

General specifications for a prime-focus ultraviolet spectrograph of moderate dispersion were drawn up in 1946 by Dr. Lawrence H. Aller (now at the University of Michigan); a grant was secured from the Research Corporation, and the order placed with the Perkin-Elmer Corporation. Difficulties with the optical design have caused some delay, but it is hoped that this instrument will be finished in the near future. Meanwhile, changes have been made in the upper end of the tube of the 36-inch to provide for attaching the spectrograph cage.

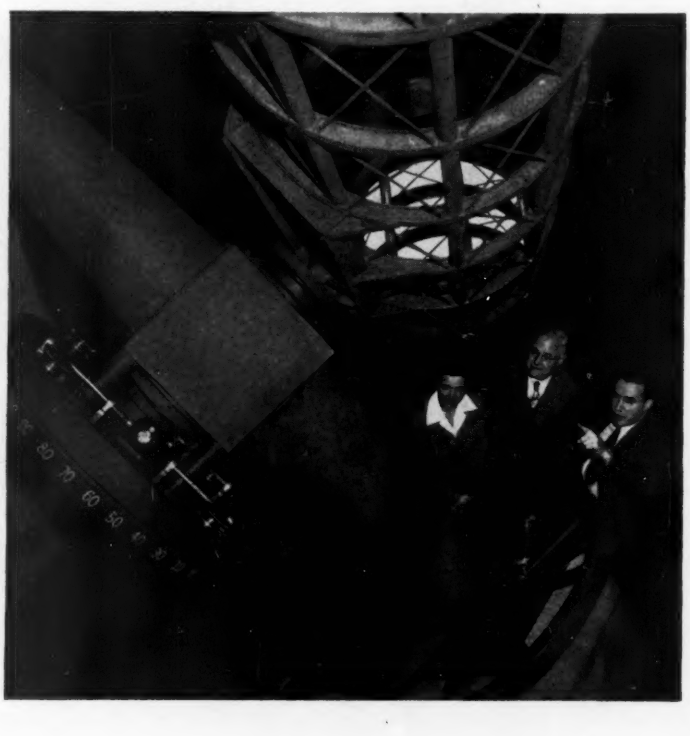
The 10-inch camera will be used for searching for lost asteroids, in co-operation with the International Astronomical Union. The lens was lent to us by Dr. Paul Herget and the University of Cincinnati for this specific program. Financial support for this work during the coming year is partly taken care of by a contract with the Office of Naval Research. The 10-inch will, of course, also be useful for some photometric problems.

The new equipment was planned by astronomers from the university in collaboration with Dr. Link, under the terms of the earlier arrangement between the university and the Link Foundation for Scientific Research.

With the acceptance of Dr. Link's generous gift, we are transferring our research activities, in name as well as in fact, to the Goethe Link Observatory. The Kirkwood Observatory on the Bloomington campus was built in 1900, and has a 12-inch visual refractor. For many years it has been a student's observatory used only for teaching, but the name has appeared on our research publications. This series is now being terminated with No. 10, and future publications will be under the name of the Goethe Link Observatory.

The Link gift also provides an opportunity for expansion of research programs and of staff. We can predict that Dr. Link's foresight and generosity are going to result in useful research that will contribute to the general advancement of astronomical knowledge.

Dr. and Mrs. Link and Dr. Edmondson discuss a feature of the mounting of the 36-inch reflector, which is of the cross-axis type.



NEWS NOTES

By Dorrit Hoffleit

COMET STATISTICS

Harley Wood, in the *Bulletin* of the New South Wales Branch of the British Astronomical Association, lists some statistics on the comets for which orbits have been determined. Of about 400 comets discovered prior to 1600, orbits are known for 55. In the successive centuries starting with 1601 the numbers with orbits have been 20, 62, and 312, while the period 1900 to 1940 has yielded 201 cometary orbits, an average of five per year. For bright comets there has been no significant recent increase: six for 1801-1850, eight from 1851 to 1900, and four for 1901-1940.

The period during which a comet is observed has increased from an average of 11 weeks for 1851-1870 to 19 weeks for 1911-1930. From 1851 to 1940 the total number of comets detected was 420, of which 236 had periods of over a hundred years, and 66 were short-period comets observed for the first time, while 118 were later returns of older periodic comets. The largest number of comets found in any one year has been 14, in 1947.

ANOTHER BIG METEORITE

The Smithsonian Institution in Washington has recently acquired an iron meteorite weighing 1,164 pounds. This is one of the largest meteorites known to have fallen in the United States. It is the Drum Mountain, Utah, meteorite discovered four years ago by two Japanese near a wartime relocation center for alien nationals. Yoshio Nishimoto and Akio Ujihara, who were conducting classes in gem cutting, were searching the countryside for specimens for classroom demonstrations when they found a very unusual-looking rock projecting about two feet out of the ground. Smithsonian authorities estimate that the mass must have struck with a tremendous force, yet there was no evidence of a crater associated with the meteorite. They believe the mass must have ricocheted or rolled from its original striking point to the site of its discovery. The meteorite has rather deep surface depressions which the experts believe to have been created before the object struck the atmosphere.

PHOTOELECTRONIC TELESCOPE

The Halley lecture for 1948, delivered May 12th on "Morphological Astronomy" by Dr. Fritz Zwicky, of the California Institute of Technology, at Oxford, England, is published in the August issue of the British journal *Observatory*. The lecture covers many phases of astronomy, one of which is instrumentation. One way of realizing "greater integrated flow of energy at the focal surface . . . than through the entrance aperture is the construction of a *photo-electronic telescope.*" Parts of such a telescope were built by RCA under the direction of V. K. Zworykin in 1941, but developments were stopped by the war.

Several of the advantages of this type of instrument are cited. Light entering the photoelectronic telescope strikes a layer of material, such as cadmium, causing it to emit electrons. The electrons can be accelerated from the image surface to increase the intensity of the light signals up to limitations set by background fluctuations. Uniform background intensity may be eliminated by electric compensation, so that sky background or the uniform disk of the sun may be scanned away. Another great asset of the photoelectronic telescope is the use of Zworykin's image stabilizer; scintillations due to unsteady atmosphere or motions of the telescope, so important in ordinary instrumentation, are stabilized in the refocused image. The telescope can be provided with automatic guiding devices. Moreover, the search for novae, comets, and the like can be "put on mass-production," since images from the photoelectronic telescope can be televised.

BUILD YOUR OWN RADAR

Radar is rapidly becoming standard equipment for the observation of meteors. While professional groups, notably in England, Canada, Czechoslovakia, and the United States, are actively engaged in radar studies of known showers, new daylight streams, and statistical meteorics, amateurs are likewise beginning to make radar-meteor observations an active hobby. A pioneer in this field for amateurs is Charles A. Little, Jr., who describes his home-built equipment in a supplement to the July-August issue of *Star Dust,* bulletin of the National Capital Astronomers, Washington, D. C.

It is important to note that for operation of such apparatus in the 11-meter band, which is shared by amateurs, industrial, scientific, and medical apparatus, a special license is necessary. Mr. Little's set consists of six units: transmitter, a high-voltage power supply (5,000 volts), receiver, indicator, indicator power supply, and the antenna system. The half-wave transmitting antenna-reflector and the receiving antenna are mounted on a 60-foot telephone pole. The carrier frequency is between 27.185 and 27.455 megacycles.

The results obtained by Mr. Little during two months of observations are encouraging. The 150 echoes he recorded verified the greater abundance of meteors between midnight and noon than between noon and midnight. He found that the distances of the observed meteors were greatest between 9 and 10 a.m., averaging 130 miles, while between 9 and 10 p.m. they averaged only 75 miles. The observed durations ranged from 0.5 to 18 seconds, but most of the meteor echoes appeared to last from 0.5 to two seconds.

AN ECLIPSE EXPEDITION

On November 1st there occurred a total eclipse of the sun, starting at sunrise near Lake Victoria in Africa and ending at sunset near New Zealand. Not many astronomers planned to observe this eclipse, but a small expedition from the Greenwich Observatory, headed by Dr. R. d'E. Atkinson, went to Mombasa, on the Kenya coast, where the eclipse was 98 per cent total, to photograph the narrow crescent sun. The purpose was to try out a method for obtaining more accurate positions of the moon from measurements of the position angles of the line of the eclipse cusps. As seen from Mombasa, this position angle was expected to swing through an angle of about 70 degrees in 2½ minutes, during which interval the astronomers hoped to obtain some 3,000 timed pictures on 35-millimeter motion picture film. Each exposure was to be 1/1,000 second long, with a green filter and a visual telescope lens stopped down to f/40. *Nature* reports that the method is expected to yield the position of the moon to a higher degree of accuracy than could be obtained from the results of 6,000 ordinary occultation observations, as not only is the timing much improved, but personal equation, systematic time differences between stations, and real changes of the moon's libration are eliminated. If Dr. Atkinson's expedition was successful, the method will probably be applied to long-range geodetic problems.

AMERICAN ASTRONOMICAL SOCIETY TO MEET AT NEW HAVEN

By invitation of Dr. Dirk Brouwer, the 80th meeting of the American Astronomical Society will be held at Yale University Observatory, New Haven, Conn., December 28-31, 1948. Registration and an open house will take place on Tuesday, the 28th, and on Wednesday there will be two sessions for papers. Two special sessions are planned for the afternoon of the 30th, a short symposium of three invited papers on microwave astronomy arranged by Professor Charles R. Burrows, Cornell University, and then a teachers' conference. The society dinner that evening will be followed by a series of talks on the recent meeting of the International Astronomical Union. The final session for papers is to be held December 31st.

The Man Who Made the Constellations Famous

By L. S. Copeland

Aratus of Soli, drawn from a copper coin of that city. Published in a work by Fulvius Ursinus, 16th-century Italian antiquary, reprinted by Basil Kennet in "Lives and Characters of the Ancient Grecian Poets," London, 1697.

ARATUS OF SOLI was publicity agent for most of the constellation figures well known among us today. Forty-eight years after the death of Alexander the Great, Aratus wrote a long astronomical poem, *Phaenomena,* which was read by the wise and well-to-do of his own age and of succeeding generations and which, escaping destruction amid the turmoils of 2,000 years, survived until it was made deathless by modern printing presses. The Parthenon is a ruin, but the *Phaenomena* is as fresh and fair as when it first was published in 275 B.C.

Lost forever are the names of the men who first ran the imaginary lines forming our constellation figures. But we may be certain that they lived in the Tigris-Euphrates valley, perhaps at Babylon. Twenty centuries elapsed while the celestial chart was being evolved. The work was done by priests, not by shepherds, because shepherds were too busy earning a livelihood to have time for intellectual pursuits. Finishing touches probably were added by the mariners of Phoenicia and Greece, and by Homer and Hesiod, poets of early Hellas.

But to Aratus we must give a laurel crown for having made the system popular and permanent. His poem was a favorite not only in Greek-speaking lands, but also in the Roman West. It was criticized by Hipparchus (2nd century B.C.), greatest astronomer of the ancient world, and admired even by Virgil. Cicero, orator and statesman, and Germanicus Caesar, nephew of Tiberius, both translated it into Latin. From its prelude Zeus himself quoted a line, if one may believe Lucian, the Greek Voltaire.

We are told that the Greeks called themselves children of the gods, and that the Romans, not to be outdone, reported that the Latins were descended from the Greeks. As Virgil wrote an epic after the manner of Homer, Manilius composed a stellar poem under the influence of Aratus. Both Manilius and Aratus have been remembered near the Sea of Serenity on the lunar chart. The Latin poet's ring, southeast of the sea, shines out big and handsome, but the Greek's memorial is only an oblong crater, seldom observed, aloft on a mountain at the southern end of the Apennine chain.

The word *Aratus,* like our given name *Samuel,* means *obtained* by prayer. Plutarch devoted one of his *Lives* to Aratus, general and statesman of Sicyon. But our interest is in the poet of the constellations, the leading amateur astronomer of the ancient world. He was reared in Soli, a city of Cilicia, and wrote his chief work in Macedonia. St. Paul also was a native of Cilicia and introduced Christianity to Europeans by carrying it first into Macedonia.

But where was Soli? On a map of the Mediterranean locate Cyprus. After placing your pencil on the easternmost tip of that major island, draw a line due north till it touches the coast of Asia Minor. The point of contact will be between Soli and Tarsus, birthplace of St. Paul. These cities were only 25 miles apart.

As a boy, Aratus may have enjoyed watching far-off ships sailing toward his home town and toward the Cydnus River. His education, begun in his home town or in Tarsus, was continued, perhaps on Cos, but especially in Athens. He studied under grammarians and philosophers, the most famous of whom was Zeno, father of Stoicism. In Athens the Solian met Callimachus, who wrote the first of those poems which introduced to the world the constellation of Coma Berenices. If the two authors discussed the stars, they failed to mention Coma Berenices, once tuft of the Lion's tail, but later transformed, by the craft of Conon (Alexandrian astronomer) and the magic of Callimachus and Catullus (Latin poet), into the shining tresses of an Egyptian queen. At least, Aratus wrote not one word about the new constellation.

Perhaps it was in Athens that Aratus met Zeno's powerful friend, Antigonus Gonatas, king of Macedonia. Antigonus invited or welcomed the Solian poet to his court in Pella, 30 miles northwest of modern Salonika, and there Aratus, encouraged by the king, elaborated the *Phaenomena.* About a year after its appearance, Macedonia was conquered by Pyrrhus, ruler of Epirus.

The death of Pyrrhus in 272 B.C. enabled the Macedonian king easily to regain his throne. Aratus, who had become a refugee at the court of King Antiochus I in Syria, gladly returned to Pella. There he lived until his death sometime before 240 B.C. In memory of him a coin was minted and a monument raised by the city of his boyhood. And now let us consider the bright lights of his poem, which men of many centuries have enjoyed.

Dr. Robert H. Baker, astronomy professor at the University of Illinois, describes the masterpiece of Aratus as a best seller of Greco-Roman times. So it was, but it was elaborated for educated readers, not for the masses. Those who loved the *Iliad* found pleasant reading also in the astronomical poem. Aratus, we know, was an admirer of Homer's works, because the poet of Soli prepared for King Antiochus an edition of the *Odyssey.* The *Phaenomena* has an antique flavor, and many of its words can be found in a Homeric dictionary. Though the phrases are picturesque, the lines might have been simpler if the author had foreseen that they would bother readers centuries after his death.

Theaters would call the *Phaenomena* a double feature. The second part, the *Weather Signs,* is interesting chiefly because, in lyric language, it unintentionally discloses how irrational was much of the thinking of that long-ago era.

But our concern is with the first part. It was based on an astronomical treatise, also called the *Phaenomena,* written about 50 years before by Eudoxus of Cnidus. After Eudoxus had studied at Heliopolis in Egypt, he brought back to Greece a celestial globe or the idea of a stellar sphere. In his manuscript why did he not describe the Egyptian, instead of the Mesopotamian, star groups? Perhaps because the Greeks for nearly a thousand years had accepted the Babylonian designs, especially Ursa Major, Bootes, Orion, the Pleiades, and

the Hyades, all mentioned by Homer.

The *Phaenomena* of Aratus begins with a beautiful prelude, in which Zeus is exalted and glorified. This prologue, condensed and freely rendered, may be expressed as follows:

With Zeus let us begin the book;
Of him we ever mindful are.
He fills the streets and marts of men,
The sea and harbors near and far.
We need him under sun and cloud,
For we his offspring also are.
He gives us signs foretelling good
And wakens us to work and earn;
He shows us when to plough and plant
And when the years and seasons turn.
For he the constellations made,
That they might teach and we might learn.
So hail we ever and again
The Father, mighty aid to men.

The Planisphere of Geruvigus, illustrating a Roman manuscript of the "Phaenomena" of Aratus, drawn in the 9th or 10th century A. D. From Basil Brown's "Astronomical Atlases, Maps, and Charts." Note winding Draco with Bears in the curves, Cassiopeia without a chair, water from the Aquarian jar, Eridanus flowing from a jar, Cetus as a sea monster (not a whale), Centaurus holding a rabbit (not a wolf).

Though the Stoic Cleanthes also portrayed the fatherhood of Zeus, we know that when St. Paul in his address on Mars Hill (Acts, XVII, 28) quoted the line, "For we are also his offspring," he was influenced by the *Phaenomena,* because the same words appear in both places, except that the apostle uses a later form of the Greek term *we are.*

The music of the prelude ceases, and Aratus, facing north, points out two *Arktoi* (Bears), from which our Arctic Circle derives its name. Zeus placed them in heaven because when he was a child they hid him in a cave and cared for him for a year. Aratus adds that they were known also as wagons because they wheel about the pole. Greek seamen steered by *Helike* (Larger Bear), he records; the Phoenicians, by *Kynosoura* (Cynosura, Ursa Minor). Next he presents *Drakon* (the Dragon) "winding interminably around and about."

As Cynosura in Greek means Dog's Tail, we have here another, and perhaps older, picture of Ursa Minor. The poet portrays this constellation as having its head in the coil of the Dragon. Though this description is not literally true, it reminds us that the Dragon stretches like a great loop along two sides of the Little Dipper.

Before us next appears *Engonasin* or On-His-Knees, "the phantom like a toiling man." No one remembers about what he is busy or why he is kneeling, Aratus remarks. But after our poet's time the mystery was solved by calling this constellation Hercules. We are told that a foot of the kneeler is over the crooked Dragon's head.

Nearby is *Stephanos* (Northern Crown), placed on high by Dionysius (Bacchus) to be "a token for abandoned Ariadne." Notice that Dionysius, not Theseus of Minotaur fame, is here the false lover. Then come *Ophiouchos,* with "such splendid shoulders," and the Serpent, which, lifting its head to Ariadne's Crown, twines around the waist of the Serpent Holder while he twists it with both hands and treads down the "great beast" *Scorpios.*

Libra appears as the huge, dimly lighted *Chelai* or Claws of the Scorpion. For its modern name was not used before the 1st century B.C.

Next far-seen Bootes rolls by, "like one who drives." He is also *Arktophylax* (Bear Guard), and he seems to touch the Bear. Though his stars are bright, under his belt is one surpassing the others — *Arkturos.* Below them can be seen *Parthenos* (the Virgin). From the same root comes *Parthenon,* maiden's chamber, name of the beautiful Athenian temple. Even in those days, Aratus reports, it was uncertain who she really was. But he interrupts his description to repeat a pretty story of the fall of man.

In the Golden Age the goddess Justice talked face to face with men. When the Silver Age dawned and mental and moral virtues weakened, she began to dwell apart from mortals, whom she vainly reproved and warned. In the ensuing Bronze Era her disappointment over the increasing waywardness of humanity caused her to desert earth for her present place in heaven.

Special mention is made of two of the Virgin's stars, the radiant ear of grain (Spica) and *Protrygeter* (the Vintager, Epsilon Virginis), which, he says, is as bright as the star under the tail of the Great Bear (Cor Caroli).

Didymoi (the Twins), *Karkinos* (the Crab), and beautifully shining Leo (the Lion) are followed by *Heniochos* (Auriga, the Charioteer). The Charioteer has on his left shoulder the sacred goat (Capella) and the dimly gleaming Kids. Below crouches *Tauros* (the Bull), upon whose forehead "the Hyades have been cast." The poet notes that one tip of the Bull's horns is also one of Auriga's feet.

Next are introduced *Kepheus* (Cepheus), his misguided wife *Kassiepeia* (Cassiopeia), and "that tragic treasure" *Andromede* (Andromeda). In describing Andromeda, our author includes a picturesque detail, "those hands upraised and widespread always." The victim's head rests on the great *Hippos* (Horse), with which she shares one star. This brilliant, "the navel," and three others, "big and beautiful," form a square on the sides and shoulders of the Horse, Aratus explains. He does not name the steed, but we know that he, too, thinks of Pegasus, because he says that the sacred animal by stamping a forefoot created a spring on Mt. Helicon.

Near the dimly starred *Krios* (Ram) and the three-sided *Deltoton* (Triangulum) shine *Ichthyes* (the Fishes), joined with bonds that meet in the Tail Knot (Alpha Piscium).

Andromeda's feet point to Perseus. There he "outreaches, coated with dust [the Milky Way] in Father Zeus." This curious phrase survived from the days when the early Aryans regarded the radiant sky as a god, Dyaus. From that word were derived *Zeus, Deus,* and the first syllable of *Jupiter.* "In Zeus" (heaven) the poet places also the Horse and the Bird (Cygnus).

On the left of Perseus are borne along the Pleiades, "celebrated among men as seven," whom Aratus mentions by name — *Alkyone, Merope, Kelaino, Elektre, Sterope, Teygete,* and *Maia.* But "as six they are seen," an early reference to the Lost Pleiad. "Small

and faint, but well-known, they roll onward night and morning, with Zeus as their cause."

The small Lyre that Hermes made from a tortoise is near the shimmering but misty *Ornis* or Bird (Cygnus). Ornis in joyous flight is carried westward. Through *Hydrochoos* (Aquarius) and *Aigokeros* (Capricornus), where "the strength of the sun" then turned in December, our poet-guide leads us to *Scorpios* and *Toxeutes* (the Archer, Sagittarius), who draws his big bow near the Scorpion's sting. And an arrow, *Oistos* (Sagitta), lies close to *Aetos* (Aquila). Having glimpsed *Delphis* (the Dolphin) above Capricornus, we admire Orion, constellation unsurpassed ("expect not to behold others more excellent") and gaze at the star-spotted *Kyon* (Larger Dog) with *Seirios* (Sirius), "which is most keenly hot." Sirius means *scorching* and the term, *is hot,* used here by Aratus, is the verb of the same word. This great star forever pursues *Lagoos* (the Hare), which is seen under Orion's feet.

Aratus is pleased to repeat an old story. While hunting on Chios, Orion angered Artemis by profanely seizing her robe. First, the goddess tore up the nearby hills. Then she sent forth the Scorpion, which vanquished and killed Orion. So, when Scorpius rises, the hero drops from sight in the west.

With prow wrapped in mist the ship of Jason, Argo (in English, *the Swift*), is being drawn stern foremost, like a boat backing up to the mainland. Beneath the Ram great *Ketos* (the word originally meant a sea-monster) menaces Andromeda, cowering afar, and below the monster winds *Eridanos,* the mournful river of stars. *Ichthys Notios* (Piscis Austrinus) floats below Capricornus, while a small outpouring of drops, *Hydor* (the Water), is scattered to the right of "noble" Aquarius.

Under the Archer's front feet small stars forming a circle roll onward (the Southern Crown; unnamed by Aratus, perhaps because it was close to the horizon in Macedonia). Next we observe *Thyterion* (Ara, the Altar), under the Scorpion's sting, and *Kentauros* (Centaurus) whose right hand holds *Therion* (the Beast), in modern times called Lupus, but of a nature not disclosed by Aratus.

Hydre (Hydra) winds and coils, stretching far, with *Kreter* (the Cup) resting about half way down its course. Near the great snake's tail, *Korax* (the Crow) hammers away at one of the coils, according to our imaginative poet.

Neither Equuleus nor Canis Minor is mentioned, but Procyon, chief star of the Smaller Dog, is beautiful near Hydra and the Twins in the poet's picture book. Altogether 45 of our stellar groups are included, besides Pleiades, Hyades, Water, and Procyon.

Thus the constellations, treasures of the night, return with the seasons as the years go by, continues Aratus. And on clear moonless nights heaven is cleft by a bright circle called Gala or Milk (the Milky Way). The poet speaks of four other belts — two tropics, the equator, and the zodiac. After describing the rising and setting of starry groups, he closes the first part of his work with the words, "In every direction the gods speak many things to men."

A British Museum coin showing the head of Aratus, issued at Soli.

The science book of Eudoxus was reborn, in lasting form, as the poem of Aratus. So successful was the work of the man of Soli that Julius Schiller, in 1627, tried in vain to Christianize the celestial sphere by giving New Testament names to northern constellations and Old Testament names to those in the southern sky. "Aratus will be remembered as long as the sun and moon," says Ovid (*Cum sole et luna semper Aratus erit*).

Examining the *Phaenomena,* we have seen that the ancient Greeks delighted in the same constellations that still hold our attention. Though the stars have been dashing along at tremendous speeds, the celestial groupings are so vast and so very far away that we can detect little change after 20 centuries. So we find that the night sky links us with long-gone ages and even with the men who lived when history began.

LETTERS

Sir:

Organization of German amateur planetary work has been progressing very nicely here of late, and we have made current and regular observational reports to the Association of Lunar and Planetary Observers in New Mexico. At present our organization consists of about seven observatories and 50 private individuals. The enclosed reports are from two of the observatories [1943-44 Observations of Jupiter, Berlin-Treptow Observatory; The 1948 Opposition of Mars, Schwaebischen Observatory, Stuttgart], and we will gladly send copies of these and other small periodicals to interested persons. We hope to organize formally all German planetary observers in the near future.

What we still lack most are optics and literature, so if you have back numbers of any astronomical periodicals, do send them on to us please.

During the first week of October, the new Astronomische Gesellschaft will hold a big meeting at Hamburg. It promises to be the first major astronomical event in postwar Germany. Most of us, of course, will attend.

ERNEST PFANNENSCHMIDT
Grimsehlstrasse 18
Einbeck, Hannover
British Zone, Germany

Sir:

Concerning flying saucers, flying disks, and mystery balloons, reports of which still persist, I believe I have had an indication of what some of them might be — at least those reported seen in daylight hours.

In September Mrs. King and I took a leisurely trip by air through the middle western states. At Rice Lake, Wis., while refueling, we noticed a strange object about 45 degrees above the horizon. It was difficult to estimate its distance from us, since we had no idea of its size. It resembled, first, a dark gray cloud in the shape of a perfect disk, moving quite rapidly in an easterly direction. Quickly it changed form, then resembling a sphere, halted in its travel, descended a bit, rose again, reversed its direction of movement, changed form to resemble a parachute, then disintegrated, reformed again into a disk, and so on.

Completely baffled, we took off to chase it down, but could not find it after we got into the air. We eliminated the possibility of its being a balloon or a parachute, for it traveled mostly against a stiff easterly wind. A few days later, at Chetek, Wis., as we sat outdoors waiting for a taxicab, we saw the dark gray disk again. However, this time it traveled toward us, and came close enough for us to see it clearly as it disintegrated into hundreds or thousands of small specks — birds! They were small, fast birds of the order of the sparrow or swallow, but we could not be sure of the exact size or species. The disk formation of bird flying was new to us.

BENJAMIN KING
Westchester Apartments
Washington 16, D. C.

Sir:

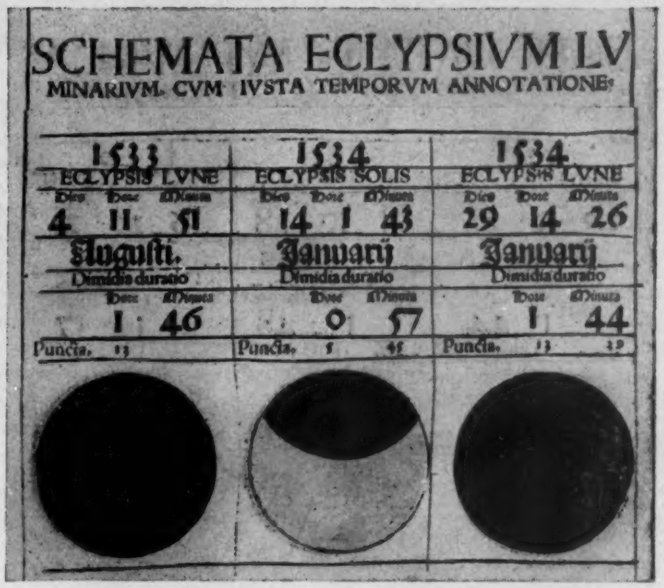
In regard to your recent news note on "A Rare Astronomical Treatise" (October, 1948, page 301), I have had a copy of **Planetary and Stellar Worlds,** by O. M. Mitchel, collecting dust on my shelves for over five years. Imagine my surprise when I discovered that a book to which I had not given a second thought was not even "home."

If you should know of any organization or individual who has been seeking this book and has not yet found a copy, any reasonable offer shall take mine. Its condition is good as books 100 years old go.

CHARLES BENEVENTO
83 Hoyt St.
Brooklyn 2, N. Y.

The Two Lunar Eclipses of 1948

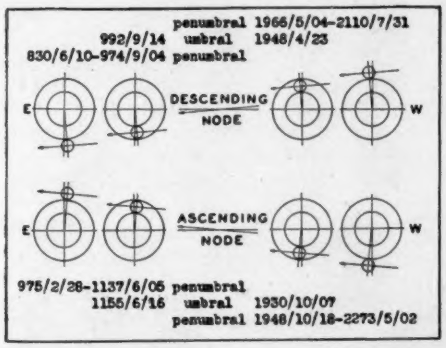
By Alexander Pogo
Carnegie Institution of Washington



The title and lower portion of a page from the Roman Calendar of Stoeffler, showing two total eclipses of the 16th century which are in the saros series that contain the two lunar eclipses of 1948.

TWO SMALL but interesting eclipses of the moon occurred in 1948. The very shallow partial eclipse of April 23, 1948, was the last umbral eclipse of a descending-node saros series (see below, third upper schematic diagram). The deep penumbral eclipse of October 18th was the first eclipse of the terminal penumbral run of an ascending-node saros series (see the third lower diagram).

On April 23rd, at $13^h\ 39^m$ Universal time, the southern limb of the moon dipped about 0.9 minutes of arc into the physical umbra; the eclipse was a mere contact with the geometrical umbra which does not take into account the empirical two per cent correction added by 19th-century computers on the basis of pre-photographic observations of the edge of the umbra. On October 18th, at $2^h\ 35^m$ Universal time, the northern limb of the moon passed within about 1.5 minutes of the physical umbra; the moon was deep within the optically effective inner layers of the penumbra; even the southern limb of the moon was within the penumbral cone. As far as terrestrial observers were concerned, there was a conspicuous darkening of the southern limb of the moon on April 23rd, and of the northern limb on October 18th; in both cases, the degree of darkening depended more on the unpredictable amount of sunlight refracted by the earth's atmosphere into the parts of the shadow cones through which the moon happened to pass than on the shallow dip or the narrow gap indicated by the magnitudes of the eclipses, 0.028 and −0.05, respectively.



The descending-node series of lunar eclipses which contains that of April 23, 1948, began on June 10, 830 (first upper diagram), and will end on July 31, 2110 (fourth upper diagram). The lower set illustrates the ascending-node series containing the penumbral eclipse of October 18, 1948.

Variations in the size of the umbral and penumbral cross sections, in the size of the moon, in the inclination of the moon's orbit, the details of the shallow encroachments or close approaches, and so on, are not shown in the diagrams.

The data on the partial eclipse of April 23rd may be found in the almanacs. Here are the circumstances of the penumbral eclipse of October 18, 1948:

Moon enters penumbra	Oct. 18^d	$0^h\ 13^m$ UT
Middle of the eclipse		2 35
Moon leaves penumbra		4 57

Magnitude, −0.05 (moon's diam. = 1.0)
Moon in the zenith at mid-eclipse, over 41° W., 10° N.

The penumbral eclipse of October 18th, visible on both sides of the Atlantic, was observed both visually and photographically. The darkening of the northern part of the moon was visible to the unaided eye for about an hour, between 9 and 10 p.m. EST, on Sunday, October 17th. This observer would describe the darkening as grayish or brownish; the flattening of the northern rim was visible to the unaided eye for at least 20 minutes — it was very conspicuous when observed through the right shade of dark glasses.

The eclipse of April 23, 1948, was the 63rd of its saros series. This descending-node saros series will consist of 72 eclipses: 9 in the initial penumbral run, 54 in the umbral run (20 initial partial, 12 total, 22 terminal partial eclipses listed in Oppolzer's *Canon der Finsternisse*), and 9 in the terminal penumbral run starting with the eclipse of May 4, 1966.

The eclipse of October 18, 1948, was the 55th of its saros series. This ascending-node saros series will consist of 73 eclipses: 10 in the initial penumbral run, 44 in the umbral run (9 initial partial, 27 total, 8 terminal partial eclipses listed in Oppolzer), and 19 in the terminal penumbral run starting with the eclipse of October 18th. Since the magnitudes of the winter eclipses of a saros series change slowly, the terminal penumbral eclipses of this saros series will remain, in the 20th and 21st centuries, easily visible to the unaided eye.

When the printing presses of Europe were young, our two saros series were in their respective runs of total eclipses. The German Calendar of Regiomontanus (Nuremberg, ca. 1474) and the Roman Calendar of Stoeffler (Oppenheim, 1518), among other almanacs, contain data on several lunar eclipses belonging to our two saros series; early lists were limited to a selection of eclipses, solar or lunar, visible in Europe. The facsimile here reproduces a portion of a page from Stoeffler's *Calendarium Romanum Magnum,* printed in black and red by Jacob Koebel. The total lunar eclipses of 1533 August 4 and 1534 January 29/30 were the ancestors of the two lunar eclipses of 1948 — ancestors removed 23 saros intervals of 6,585.32 days.

OCTOBER ECLIPSE REPORTS

Several observers have reported watching the penumbral eclipse of October 17th. Franklin W. Smith, Boston, Mass., writes:

"I happened to look up at the moon and noticed at first glance that the region near the north pole was less bright than the rest of the disk. Then I recalled that the moon was just full and approaching its ascending node; hence I was observing an appulse* as described in Terminology Talks [October, 1948, page 305]. . . . The moon must have passed very close to the boundary of the umbra."

Paul W. Stevens, Rochester, N. Y., knew about the eclipse in advance, but clouds prevented his observing it.

*Dr. Pogo sees no reason for continuance of the vague term "appulse" to denote a penumbral eclipse. The term is also rather loosely applied to such events as a conjunction of heavenly bodies or the culmination of a star, whereas the words "penumbral eclipse" leave no doubt as to their meaning.—ED.

JUNIOR STAR DUST

The first number of a bulletin by and for the junior members of the National Capital Astronomers has been published under the title **Junior Star Dust.** It is of the same form as the society's regular publication, **Star Dust,** and will be issued bimonthly.

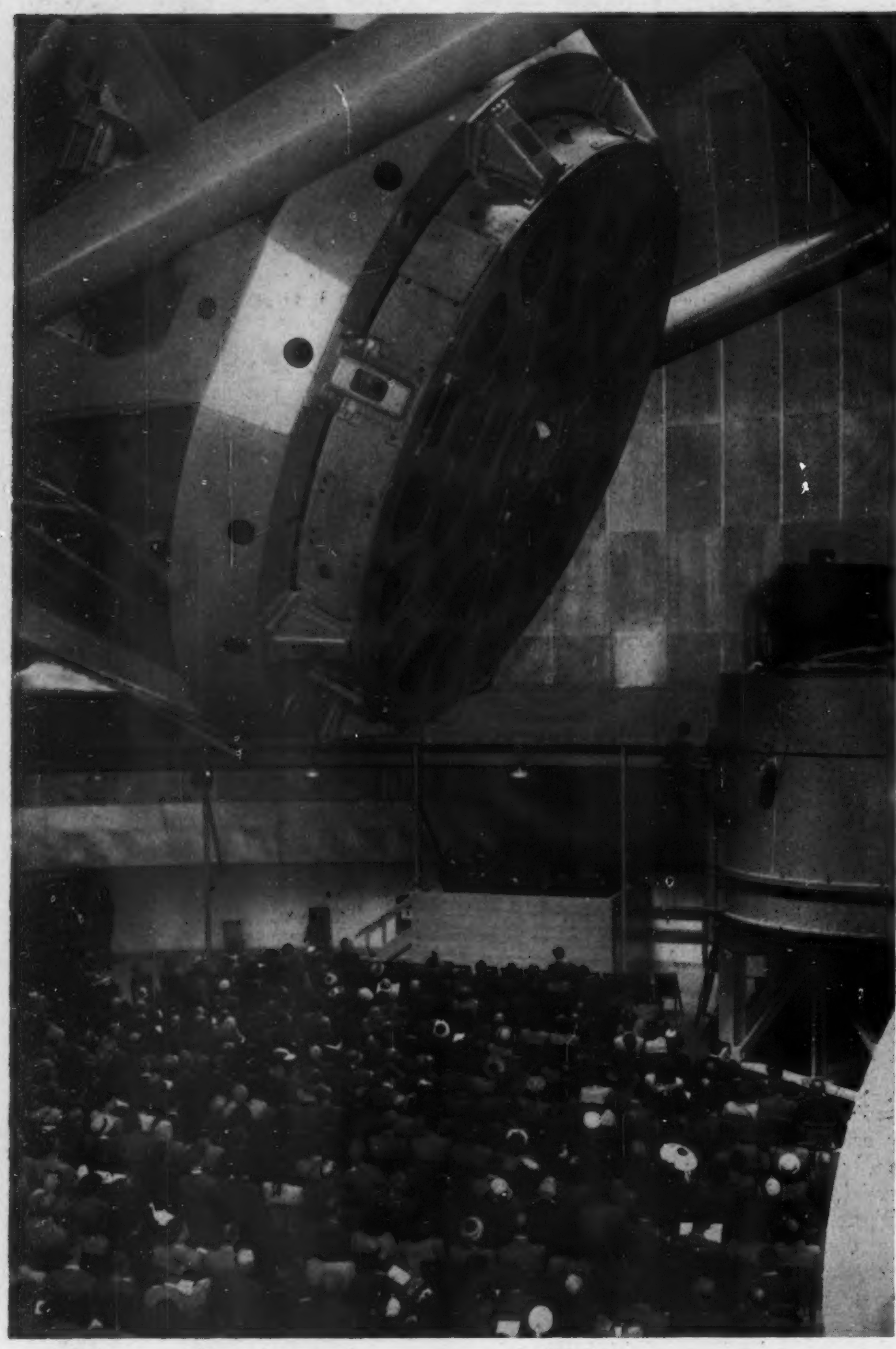
Some Astronomical High[lights]*

By Harlow Shapley, *Harvard College O[bservatory]*

THESE events are among the astronomical high points of the year now closing, but no special significance is to be attached to the order in which I present them:

1. The International Astronomical Union, after an interruption of 10 years, again had a full session, in Zurich, Switzerland, with nearly 40 international commissions in action. New commissions on microwave research, close binaries, and astronomical history were set up. The bureau on variation of latitude made an excellent report on the wandering of the earth's poles. In the operation of its five collaborating observatories, in America, Italy, Russia, and Japan, the bureau is a sort of United Nations of geodesy. Dr. Bernard Lyot, of the Pic du Midi Observatory in France, reported on his continuing magic touch in coronagraphy; and the Moscow astronomers revived the war-interrupted Prager-Schneller handbook of variable stars. International co-operation was completely cordial. The union received invitations from America and from Russia to hold the next meeting (1951) in Pasadena or Leningrad, respectively.

2. The fifth satellite of Uranus was discovered by Dr. G. P. Kuiper with the McDonald Observatory 82-inch reflector. Heaven knows we have plenty of satellites already, but this small, swift-moving 17th-magnitude object joins the big family of satellites now recognized and adds usefully to the complications of a solar system that no theory of origin has yet satisfactorily explained.



The dedication on Palomar Mountain, June 3, 1948. Photograph by Mars F. Baumgardt.

3. The formal dedication of the Palomar 200-inch reflector, together with conspicuous advance in its final adjustment, is the telescopic highlight of the year. The inauguration of the work of its smaller but mighty 48-inch Schmidt neighbor on Palomar Mountain is another notable development in the Schmidt revolution that had already been well opened by the instruments at Warner and Swasey Observatory, at Tonanzintla in Mexico, at Harvard's Oak Ridge station in Massachusetts, and on Palomar.

4. An interstate meteorite, the Norton achondrite, fell along the Kansas-Nebraska line on February 18, 1948, adding many specimens to our small collection of meteorites of this rare type. The largest piece, weighing about a ton, was acquired jointly by the University of Nebraska and the Institute of Meteoritics of the University of New Mexico.

5. The 100th white dwarf was announced during the year by Dr. W. J. Luyten, of the University of Minnesota, who has discovered 61 of these important neighboring stars, using for his work on positions and motions the Harvard South African Bruce plates, and for work on colors the data obtained by himself and others at the Steward Observatory in Arizona and the Cordoba Observatory in Argentina.

6. The proposed creation of an international observatory or laboratory has progressed through official steps taken by the Economic and Social Council of the United Nations and by UNESCO, but much more stepping will be necessary before this dream is realized. The threefold object is to advance astronomical science, to help in the rehabilitation of the astronomy of war-torn countries, and to provide an example of international co-operation that might be usefully followed in other scientific and cultural fields. Further progress may be made through an interscience conference, under UNESCO auspices, and through the establishment of an international all-science computational laboratory.

7. Important progress has been made

*Adapted from the author's traditional talk at the annual dinner of the American Association of Variable Star Observers, Cambridge, Mass., October 16, 1948.

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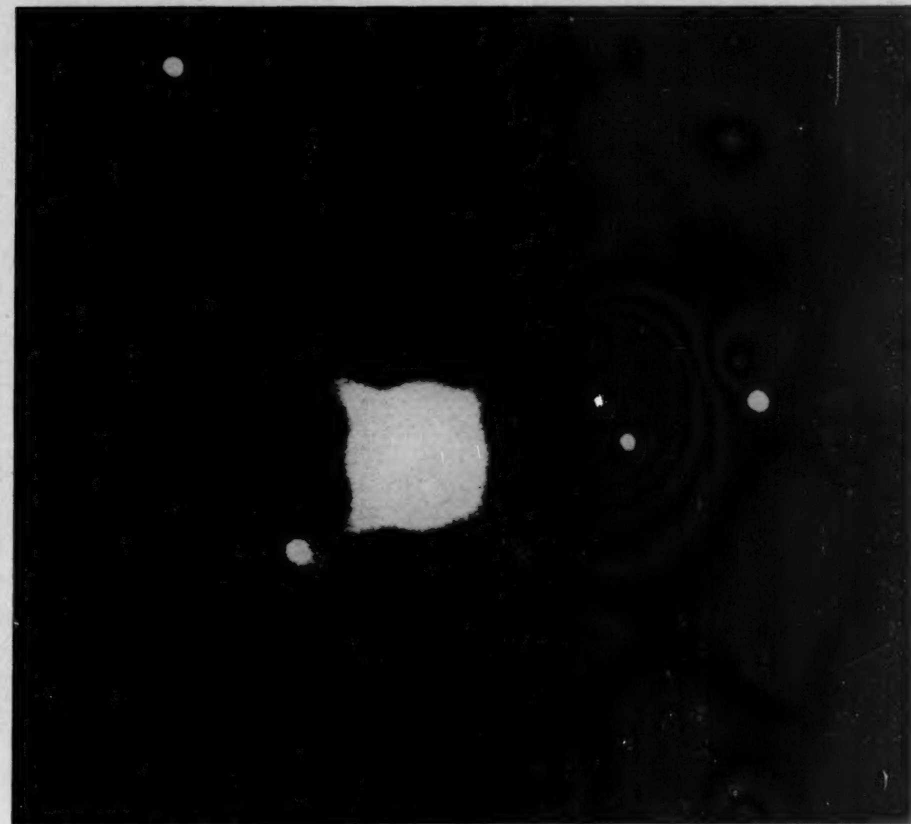
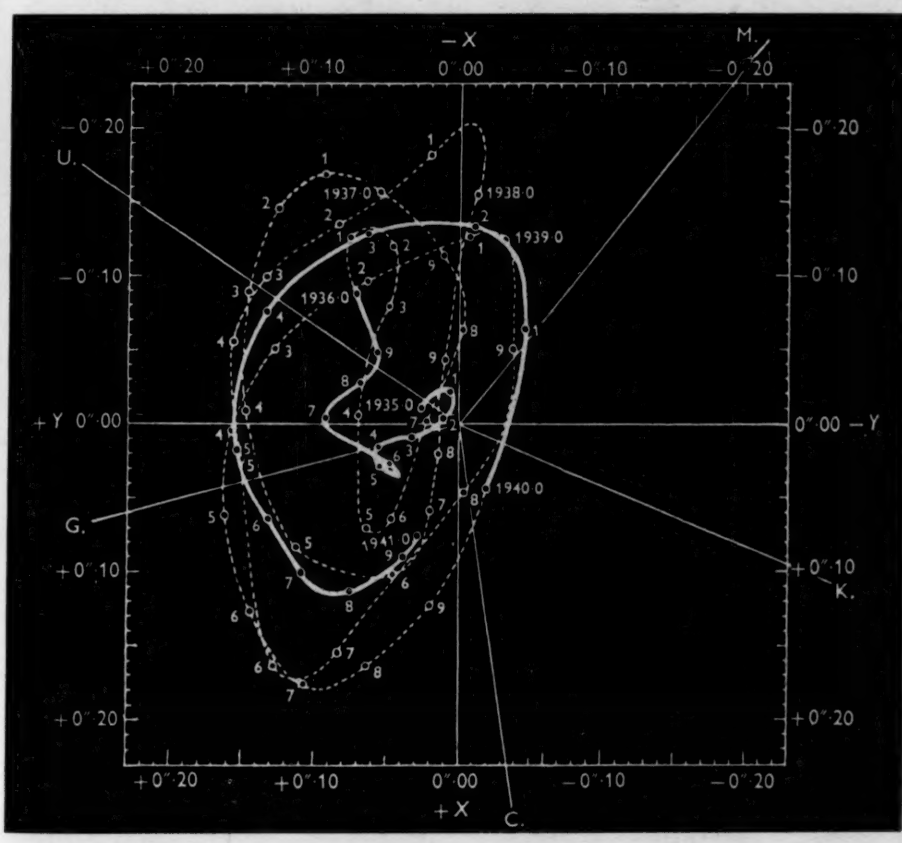
by Horace W. Babcock, of Mount Wilson Observatory, on the discovery and study of the general magnetic fields in certain stars, among them the spectrum variables. Some rapidly rotating stars, however, where strong fields might be expected, show no magnetic effect in the structure of their spectrum lines because their rotational axes are too highly inclined to the line of sight. An unpublished report comes from Germany that the relatively weak magnetic field of the sun as a whole has disappeared, or perhaps was never quite securely established.

8. Plans were completed for a Baker-Schmidt telescope of 32 inches aperture, to be operated jointly by the Armagh Observatory, North Ireland, the Dunsink Observatory, Dublin, Eire, and Harvard Observatory. Known as the Armagh-Dunsink-Harvard reflector, this instrument is to use the two-pier mounting of the Bruce telescope on Harvard Kopje, South Africa, and it should be in operation in about a year. A heavy program of research on stars and galaxies will be undertaken, with special attention paid to the galactic nucleus. The telescope's function as an instrument of good will and international co-operation is generally recognized.

9. The firm establishment during this past year of microwave astronomy as one of the principal branches of our science is here listed in recognition of exceptionally fine work, particularly in Canada, England, and Australia. In several different fields astronomical knowledge is now enriched through the use of ordinary radar and similar apparatus operating in the interval of the electromagnetic spectrum from one centimeter to 15 meters wave length. The present projects of microwave astronomy are cosmic static, solar "noise," reflection of radio signals from the moon's surface (and perhaps later from the planets), the recording of meteors



Uranus and its five satellites. Oberon is uppermost; Ariel is below left center; Umbriel and Titania are at the right. Satellite V, of the 17th magnitude, is inside the halation ring of the overexposed image of the planet. The satellite is at a mean distance of 81,000 miles from Uranus. The picture was taken with an exposure of 3½ minutes, March 1, 1948, with the 82-inch McDonald reflector.



The position of the pole of rotation of the earth "wanders" over an area about 40 feet in its greatest extent, as shown by this chart from the report of Commission 19 of the International Astronomical Union. The average motions of the pole, as observed by five stations around the world near latitude 39° 8′ north, are plotted at 1/10-year intervals for six years, 1935 to 1940 inclusive. The motion for 1935 is a solid line starting near the origin of co-ordinates; then each year is dotted until 1940, which is a large solid loop. The smallest units of the co-ordinate scale are 1/100 of a second of arc, or very nearly one foot; thus 0″.20 on the chart scale represents about 20 feet of length on the earth's surface.

The directions from the north pole to the five participating latitude stations are shown and marked with initials corresponding to the station names: Gaithersburg, Maryland; Ukiah, California; Mizusawa, Japan; Kitab Kaska, Turkestan; and Carloforte, Sardinia.

(which can also be done through clouds or in full sunshine, and with startling results as to numbers), and the exploration of the earth's atmospheric strata and their changing electrical conditions. Electronic engineers, not astronomers, do most of the new work in this new branch of astronomical research.

Postscript: Just outside the report year, but further developed during the past summer, were the remarkable observations at Mount Wilson by Drs. Joel Stebbins and A. E. Whitford, of Washburn Observatory, on the increasing redness with distance for faint galaxies. This was a photoelectric research — an outstanding contribution in the rapidly developing field of high-precision stellar photometry, which is based in turn on the highly dependable photomultipliers and other electronic equipment developed in the past few years.

Amateur Astronomers

The Annual Meeting of the AAVSO

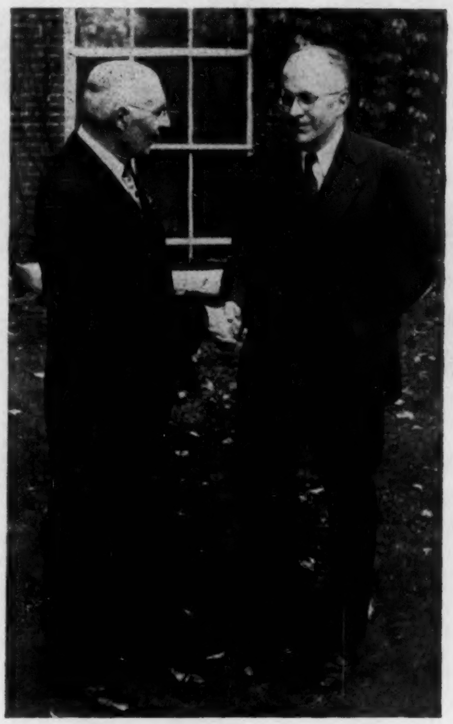
On the evening of Friday, October 15th, a large gathering of members from three organizations crowded into Harvard Observatory. The Bond Astronomical Club and the Amateur Telescope Makers of Boston participated in this opening session of the 37th annual fall meeting of the American Association of Variable Star Observers. The guest speaker was Dr. Charles H. Smiley, of Ladd Observatory, Brown University, who described his recent annular eclipse expedition to Siam, and showed color slides. A social hour of refreshments and observations concluded the evening's program.

Business sessions Saturday morning and afternoon, with Acting President David W. Rosebrugh in the chair, brought reports from committee chairmen, and the customary annual report of the recorder, Leon Campbell. During the year 35 new members have joined. The total number of variable star observations reported to headquarters was 54,370 by 154 observers, 4,000 more than in 1946-47. The solar division reported a total of 10,374 observations.

The society's ninth merit award was presented to Cyrus F. Fernald, of Wilton, Me., who again made the highest number of observations during the year. The award was in recognition of his outstanding work for the association, particularly in preserving the continuity of many light curves during the war.

Officers for the following year are: Mr. Rosebrugh, president; Neal J. Heines, first vice-president; Dr. Martha E. Stahr, second vice-president; Clinton B. Ford, secretary; Percy W. Witherell, treasurer; Leon Campbell, recorder.

A resolution was adopted by the AAVSO concerning the preservation of Meteor Crater as a national or state park; it was similar in form to resolutions already adopted by the American Astronomical Society and the Astronomical League.



Fred E. Jones, AAVSO merit award artist, congratulates Cyrus F. Fernald, recipient of the ninth award.

The AAVSO has lost one of its most faithful observers of the sun, the Reverend W. M. Kearons, of West Bridgewater, Mass., who died this summer.

Papers of varied and specific interest presented during the meeting included

THIS MONTH'S MEETINGS

Chicago, Ill.: "Eclipses Through the Universe" will be discussed by the director of the Adler Planetarium, Wagner Schlesinger, at the meeting of the Burnham Astronomical Society on Tuesday, December 14th, 8:00 p.m. at the Chicago Academy of Sciences.

Cleveland, Ohio: The Cleveland Astronomical Society will hold a Christmas party at its December 10th meeting, 8 o'clock at the Warner and Swasey Observatory.

Detroit, Mich.: At the meeting of the Detroit Astronomical Society on Sunday, December 12th, "The Story of Palomar," a documentary sound film in color, will be shown. The meeting is at 3:00 p.m., in Wayne University.

Duluth, Minn.: The Darling Astronomy Club will meet on Friday, December 3rd, at 8:00 p.m., at the Darling Observatory, and Robert H. Schmidt will speak on "Comets."

Geneva, Ill.: On Tuesday, December 7th, the Fox Valley Astronomical Society will hear a discussion of "The Christmas Star," by Robert L. Price, of Joliet Junior College, at the Geneva City Hall at 8 o'clock.

Indianapolis, Ind.: The board of officers of the Indiana Astronomical Society will conduct a "1948 Review" at the December 5th meeting, 2:15 p.m. in Cropsey Hall.

Los Angeles, Calif.: "The Story of Palomar," a color film, will be shown at the Los Angeles Astronomical Society's December 14th meeting, at the Griffith Observatory, 7:45 p.m.

Madison, Wis.: "The Study of the Stars" is the topic of J. E. Nuquest at the meeting of the Madison Astronomical Society, 8 p.m. at Washburn Observatory on December 8th.

New York, N.Y.: Dr. Dirk Brouwer, of Yale University Observatory, will speak on "Asteroids: the Little Planets," at the December 1st meeting of the Amateur Astronomers Association, 8:00 p.m. in the American Museum of Natural History.

Pittsburgh, Pa.: J. A. Pruett, of the U. S. Weather Bureau, County Airport Station, will talk about "Weather and World War II" on December 10th at 8:30 p.m., at the meeting of the Amateur Astronomers Association in the Buhl Planetarium.

San Diego, Calif.: The San Diego Astronomical Society will meet December 3rd at 7:30 p.m. in the Gas and Electric Building, Room 504. Dr. Charles J. Krieger, formerly of Lick Observatory, will speak on "Present Views of the Extragalactic Nebulae."

Stamford, Conn.: On Friday, December 17th, at the Stamford Amateur Astronomers meeting at the Stamford Museum, Robert Norton, of the United States Power Squadrons, will speak on "Celestial Navigation for Astronomers."

Washington, D. C.: Dr. John S. Hall, of the U. S. Naval Observatory, will lecture at the meeting of the National Capital Astronomers on Saturday, December 4th, at 8:15 p.m., in the Commerce Department auditorium. His topic will be "Measuring Starlight."

AN EXHIBITION OF NATURE PHOTOGRAPHY

The Detroit Astronomical Society is one of the sponsors of the Third Michigan International Exhibition of Nature Photography. Astronomy is included among acceptable subjects, and the society will give an award for the best amateur's photograph of any astronomical subject. The last day for receiving entries is March 14, 1949; accepted prints will be exhibited at the Detroit Flower Show and at the Cranbrook Institute of Science. Entry blanks may be procured from Roger E. Richard, Chairman, 1832 N. Gulley Rd., Dearborn, Mich.

RENSSELAER OPEN NIGHTS

As in past years, the Rensselaer Astrophysical Society is conducting open nights at the observatory of Rensselaer Polytechnic Institute. In December these are scheduled for the 7th and 21st, from 7:30 to 9:30 p.m.

two on the use of photoelectric equipment, by J. J. Ruiz, of Dannemora, N. Y., and Stanley Brower, of Plainfield, N. J. Mr. Ruiz described in most amusing fashion the foibles of an amateur making his first photoelectric equipment, and while he warned his audience of the difficulties to be met in this work, he stated that he was going right back home to improve and develop his own equipment. His photometer is for his 6-inch Newtonian telescope, and is to be used for variable star work. During its construction he awarded himself a "degree of Doctor of Photo Electricity, or DOPE." Mr. Brower also described experiences in building a photometer, and strongly recommended the use of refrigeration to get rid of dark-current noise. He showed a container built for this purpose, and discussed the use of dry ice.

Dr. Dorrit Hoffleit, of Harvard, discussed her investigations of a suspected RV Tauri-type star discovered to have bright lines in its spectrum by Dr. A. N. Vyssotsky at McCormick Observatory, and further studied on slit spectra by Dr. A. H. Joy at Mount Wilson Observatory. Dr. Hoffleit, by a study of Harvard plates from 1899 to April, 1948, confirmed the semiregular variability of this star, BD $+20°2337$, but did not find the alternate shallow and deep minima sometimes considered typical of RV Tauri stars. This star is within reach of AAVSO observers, as its visual magnitude ranges probably from about the 10th to the 12th magnitude.

Other papers included such diversified topics as the problems of a chart curator, by Richard Hamilton, South Norwalk, Conn., visual and photographic planetary observations, by John W. Streeter, Vassar College Observatory; and the decrease in solar granulation as sunspot activity wanes, by Dr. James C. Bartlett, Baltimore, Md. Dr. Harlow Shapley, of Harvard, presented "typical" Cepheid light curves as determined from 88 Cepheid stars in the Magellanic Clouds.

At the annual dinner Saturday evening, Dr. Shapley presented his traditional highlights of 1948 (see page 42), and several astronomers who had attended the Zurich congress of the International Astronomical Union, among them Dr. Dirk Brouwer, of Yale University Observatory, gave their impressions of that meeting. H.S.F.

SACRAMENTO FAIR EXHIBIT

About 300 square feet of space were allotted to the Sacramento Valley Astronomical Society for its second annual exhibit at the California State Fair, early in September. Attendance at the fair was 600,000. Growth of the society was assured by the large number of visitors who submitted membership applications or took some with them; it was expected the paid membership of the SVAS will be doubled.

A blue and gold color scheme prevailed at the astronomical exhibit, where two refractors and four reflectors were on display. A 10-inch reflector showed sunspots by day and the stars at night, and on occasion two instruments were operated to relieve the pressure of the crowds.

Among the displays was a scale model of the sun and the solar system, and another exhibit showed, by luminous plastics, the operation of a refractor and of a reflector. The incoming light appeared in one color, the light in transit from the primary to the secondary in a second color, and then to the eyepiece in a third color.

There was keen competition among exhibitors in the Educational Building. The SVAS won a special award and a bronze plaque for its efforts.

HELEN SCHOPKE
Secretary-treasurer, SVAS
3111-12th Ave., Sacramento 17, Calif.

In Focus

ORION now begins his annual march across the skies of winter, and brings with him what is described in the Lick publications (Vol. XIII) as "one of the most wonderful regions of the sky." The central parts of the constellation contain many striking nebulosities, as shown by the accompanying picture of the belt and sword. This three-hour photograph was taken at Harvard's South African station on December 21-22, 1943, with a 3-inch Ross-Tessar lens, 12-inch focal length. It is shown with south at the top, as viewed directly by an observer in the Southern Hemisphere, and agreeing in orientation with the back cover.

Of the three stars in Orion's belt, the easternmost is Zeta Orionis (Alnitak), and the nebula NGC 2024 follows it so closely that in the back-cover picture the star's overexposed image merges with part of the nebulosity. This closeup of NGC 2024 was made with an exposure of over 5½ hours with the 100-inch Hooker reflector of Mount Wilson Observatory. The Lick publication states that the nebula covers an area about 20 by 16 minutes of arc, shows a wealth of structural detail, and is divided into two irregular masses by a wide dark lane.

In the lower left corner of the back cover is NGC 2023, an irregular nebulosity about six by four minutes in area surrounding a star of magnitude 9. In the Orion field picture, the nebula and star appear as a stellar image directly north of Zeta Orionis. Above Zeta in the field picture, the dark Horsehead nebula (I 434) may be seen against the brighter background, and the Great Nebula (M42) in Orion's sword is in the top center.

BOOKS AND THE SKY

READINGS IN THE PHYSICAL SCIENCES

Edited by **Harlow Shapley, Helen Wright,** and **Samuel Rapport.** Appleton-Century-Crofts, Inc., New York, 1948. 501 pages. $3.00.

THIS BOOK is just what its name suggests, a collection of readings loosely linked by some connection of each with science, engineering, the philosophy or methods of science, or the personality of scientists. There are six parts: Science and Scientific Method, Astronomy, Geology, Mathematics, Physics, Chemistry.

In Part One, about method, eight authors are represented, from T. H. Huxley to Irwin Edman and Raymond B. Fosdick, in approximately chronological order. "Astronomy" has 12 authors, from Copernicus to Ira Sprague Bowen and Herbert Dingle. "Geology" contains readings from 10 pens, beginning with Sir Archibald Geike and ending with David E. Lilienthal (whose piece is "TVA: Democracy on the March") and Wolfgang Langewiesche ("What Makes the Weather").

"Mathematics" with four authors occupies only 34 pages. The largest part is "Physics," 14 authors, with 119 pages, including 28 devoted to excerpts from **Atomic Energy for Military Purposes.** "Chemistry" runs to 88 pages, with nine authors represented. In addition, Part One contains seven pages of brief "Thoughts on Science" by 22 thinkers from Aristotle to Einstein. There are more "Thoughts" under "Mathematics"— a selection of 13 authorities from Plato to Whitehead. At the end of each part are two or three pages of bibliography, with, understandably, no dearth of references to Harvard writers — although P. W. Bridgman's studies are unaccountably ignored. The book closes with two or three lines of biographical notice for each of the authors, and an index.

The emphasis throughout is on contemporary work; thus the median date of the astronomical readings is 1941. The editors extend thanks for helpful suggestions to nearly a dozen people. They restrict their own comments to a short preface, followed by a couple of pages addressed to the student, and equally short introductions to each part. There are also some footnotes — the one on page 102 contains an astronomical slip.

Amid such an array of interesting intelligences the mature reader who is already skilled in a special science may move with profit and pleasure. He is sure to find some stimulating novelty. But the editors have set themselves a much more ambitious aim, which they define in the preface by a quotation from **Higher Education for American Democracy** (A Report of the President's Commission on Higher Education), as follows:

"It is the task of general education to provide the kinds of learning and experience that will enable the student . . . to apply habits of scientific thought to both personal and civic problems, and to appreciate the implications of scientific discoveries for human welfare . . . ; [to] bring to the general student understanding of the fundamental nature of the physical world in which he lives and of the skills by which this nature is discerned. That the student grasp processes involved in scientific thought and understand the principles of scientific method is even more important than that he should know the data of the sciences."

Perhaps in any case these are impossible objectives for a not-hard-to-read compilation of 501 pages. But this book falls even shorter of its objectives than necessary because the editors sponsor a wholly inadequate view of the methods that are essential in a fully developed science. Although this is a book for physical science, which, of course, is thoroughly mathematical in its upper reaches, the main emphasis as regards scientific method and the quality of scientific reasoning is placed on an article by a writer on biology, T. H. Huxley, 1863, "The Method of Scientific Investigation"; and on one from a geologist, W. M. Davis, 1922, "The Reasonableness of Science." Huxley asserts that "the method of establishing laws in science is exactly the same as that pursued in common life," but the critical reader will notice that to Huxley the supposedly established empirical regularity, **All hard green apples are sour,** seemed on a par with Newton's laws of motion!

This observed regularity is not even quantitative, as Kepler's were. Even today biology and geology are not notable for quantitative concepts and highly ab-

NEW BOOKS RECEIVED

THE COMPUTATION OF ORBITS, *Paul Herget,* 1948, published by the author, University of Cincinnati Observatory. 177 pages. $6.25 (educational and professional discount, 20%).

A textbook on celestial mechanics of special value to those interested in problems in practical astronomy concerned with the orbits of planets, comets, and asteroids.

A CONCISE HISTORY OF MATHEMATICS, *Dirk J. Struik,* 1948, *Dover.* Vol. I, 123 pages; Vol. II, 176 pages. $1.50 per volume; $3.00 per set.

The first volume of this pair traces the Oriental and European beginnings; the second volume develops the history of mathematics through the 17th, 18th, and 19th centuries.

stract principles. Instead of stressing Davis' confusing fable about the hermits, and Huxley's green apples and his little fiction about the "scientific" detection of a burglar (decades before there was even an understanding of fingerprints), why didn't the editors include a clear account, by way of Tycho, Kepler, Newton, of the three necessary and somewhat discontinuous stages in the establishment of a fully operative science? These are: accumulation of observations, discovery of empirical quantitative regularities, and synthetic theory which goes far above the scope of mere common sense and everyday reasoning. The book, in consequence, lacks organization.

The editors give Newton extreme credit because of his personal gifts as an intuitive thinker, but avoid mention of Sir William Cecil Dampier's summation in **A History of Science** that "the age of Newton was the age of the first great synthesis of scientific knowledge." Throughout these **Readings** there is lack of stress on the importance of quantity in physical science. True, on page 88, in F. R. Moulton's "Influence of Astronomy on Science," that noted mathematical astronomer says, "With the publication of Newton's **Principia** in 1687, physical science entered on a new and glorious period. The transition from the old to the new was sudden, and the completeness of the revolution in point of view has perhaps never been equalled in science or in any other field of human endeavor."

This is a splendid statement of a world-shaking fact, but the attention of the general student to whom the book is addressed is unlikely to stray to it. A degree of synthetic abstraction in psychology and politics comparable to that introduced in physical science by Galileo's and Newton's studies of distance, time, and mass, is requisite if fully developed scientific thought is to be applied to "personal and civic problems." A book can only be misleading which gives the general student the impression that the Aristotelean syllogism, **All hard green apples are sour,** is representative of the most eminent degree of scientific thought.

But perhaps higher education for democracy cannot rise as high as that, so the true democrats must deny existence to the top — a procedure for which there is much democratic precedent. Whatever the editors of these **Readings** may have intended, Sydney Hook, the author of "Education for Modern Man," makes the point clear in his current New York **Times** review of the recent book about education by James Bryant Conant:

"Mr. Conant goes farther than Bergson in believing that not merely modern science but the whole of science came down from heaven to earth along the inclined plane of Galileo. He does not come to grips with the alternative view that the basic logic of science is continuous with the controlled common sense procedures of men in mastering problems within their daily arts . . . . It is safe to say that men were scientific in some of their activities long before modern science was born."

Such a lively disagreement among the doctors would be very educational for the general student if he were provided with readings about it. Indeed, if he is of an independent cast of thought, he will find aid in previously published readings, especially, **A Source Book in Astronomy,** 1929, by Harlow Shapley and Helen E. Howarth, and **Cambridge Readings in the Literature of Sciences,** 1924, arranged by William Cecil Dampier Whetham and his daughter.

JOHN Q. STEWART
Princeton University Observatory

OBSERVER'S HANDBOOK FOR 1949

Dr. Frank S. Hogg, director of David Dunlap Observatory, Richmond Hill, Ontario, wrote on October 23rd that "the **Observer's Handbook** of the Royal Astronomical Society of Canada is again on the press." Among its new features are a time map which includes most of North America; the table of time corrections to get standard time is expanded to include more representative American cities; tables of sunrise are expanded to reach as far south as latitude 32° north; tables of moonrise extend south to 35° north. At the request of some observers in the solar division of the AAVSO, a table of solar rotation numbers will be inserted in the **Handbook.**

Orders for the **Handbook** may be placed by sending 40 cents (in coin or money order) to the General Secretary, Royal Astronomical Society of Canada, 3 Willcocks Street, Toronto, Canada. The society has many members in the United States and abroad. Anyone seeking to join the society, which publishes a well-known **Journal,** may inquire about membership to this same address.

THE INDEX TO VOLUME VII

of Sky and Telescope is on the press. Order it now for early delivery. Previous volumes are also fully indexed, and all indexes are 35 cents each postpaid. Send 35 cents in stamps or coin or include with your renewal check or money order.

BOUND VOLUMES, at $6.50 each postpaid, are available for Volumes II, IV, V, and VI. Volume VII (November, 1947, to October, 1948) in bound form will be ready soon.

SKY PUBLISHING CORPORATION

GLEANINGS FOR ATM's

Novel Drives for Amateur Telescopes

TEN YEARS ago there appeared in The SKY (July, 1938) an article concerning my 9-inch reflector of open-tube construction, which was mounted on a movable platform. Since then I have added several refinements to the instrument, including an electric drive in declination.

In the original telescope, movement in right ascension was taken care of by a 12-watt Telechron motor, but motion in declination was actuated through a worm gear by means of hand controls mounted directly on the worm-gear housing. Setting in declination required gauging how many turns of the handwheel effected a change of a specified number of degrees in the position of the field of view. This necessitated several trips between eyepiece and control, often accomplishing not-too-precise results.

I had an old 1/50 horsepower single-phase motor with built-in gear reduction in the ratio of 70 to 1. In order to convert this to a reversing motor I made several changes in the leads and ran it through a double-throw knife switch located with all other controls on a panel conveniently mounted near the eyepiece holder. The motor itself is mounted on the declination shaft housing and is connected to the declination worm through an 18-tooth brass spur gear and a 120-tooth brass spur gear.

The arrangement is shown by the accompanying pictures. Fig. 1 shows the declination driving mechanism: the motor

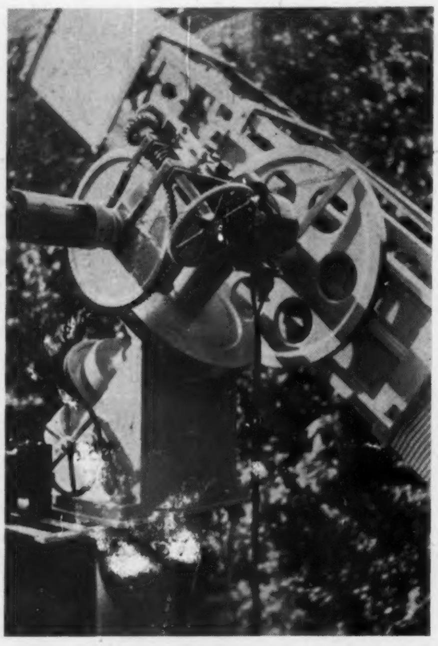


Fig. 1. The declination driving mechanism of Mr. Friend's 9-inch reflector.

GLEANINGS is always ready to receive reports and pictures of amateur instruments and devices, and is open for comments, contributions, and questions from its readers.

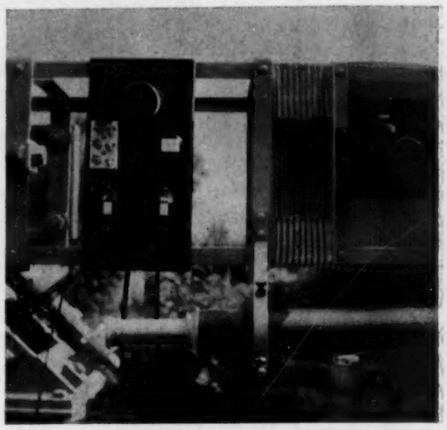


Fig. 2. The control panel near the eyepiece end of the tube, and the finder.

nearest the telescope tube, then the small and large gears mentioned above. The straps permit unclamping of the driving worm from the final gear on the declination axis itself.

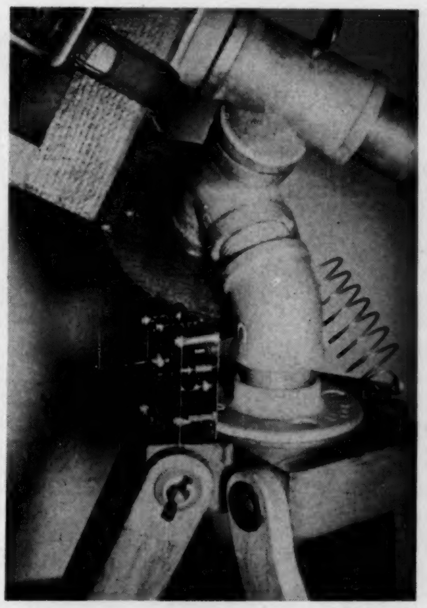
Fig. 2 shows the control panel to the left of the eyepiece and finder assembly. At the top of the panel is the switch for the right-ascension Telechron motor; at left center is the knife switch for the reversing motor, and to its right is a small neon light to illuminate the panel. The bottom switches are to turn on the neon light (right), and to operate the reversing motor.

The system works very smoothly. A sharp tap on the motor button moves the field of view a small fraction of a degree. It is extremely interesting to set the telescope on a crowded star field, as in Cygnus, keep a finger on the button, and watch the stars float across the field like so many slow-moving meteors.

IRVING H. FRIEND
40 Cooper St.
Torrington, Conn.

MANY telescope makers should be encouraged to put simple clock drives on their telescopes when they know how easily it can be done. I have two telescopes, and the accompanying pictures show the drives which are attached to each.

My smaller instrument is a 6-inch reflector with a plywood tube. The works from an alarm clock are mounted on the left side of the tripod top. The mainspring was removed and a drum 1⅜ inches in diameter was pressed onto the key-wind shaft in place of the mainspring. One end of a length of 0.020-inch music wire was soldered to the drum. The wire makes 1½ turns around the polar-axis pulley and the other end is fastened to one end of a tension spring. This spring is in turn hooked over a screw that sticks out from the side of the tripod top.



The 6-inch reflector mounting, with the clock works, driving spring, and polar-axis drum all visible.

The polar-axis pulley is fastened to the polar-axis shaft by means of a cone clutch so it is possible to turn the telescope to any point of the sky by slipping this clutch. The key-wind shaft makes four revolutions per day, so the polar-axis pulley was made four times as large as the drum on the clock. The spring keeps a tension on the music wire and the wire pulls on the drum, making the clock run. In other words, the spring tries to pull the telescope westward and the clock regulates the rate at which the telescope moves. After it has been running for

The weight-driven device, showing how the weight hangs from the tripod head.

some time the tension in the spring weakens, and the spring is then stretched again by turning the winding key to rewrap the music wire onto the drum.

My other instrument is a 12½-inch f/5 reflector, for which clock works are again used, but driven by a weight, as shown in the bottom of the picture of the mounting. In this case a gear pressed on the key-wind shaft meshes with a gear on the polar-axis shaft. These gears have a ratio of 1 to 4. A pulley is fastened to one end of the polar-axis shaft and one end of a cord attached to it. The cord then goes through a small pulley that is fastened to the tripod, down to a pulley attached to the weight and up to be tied to the under side of the tripod top. The large gear rests on the inner race of a ball bearing. There is a cardboard disk between the gear and a steel disk that is fastened to the pipe tee which serves as a declination shaft bearing. When the telescope is in place its weight makes just the right amount of friction for driving the telescope.

The regulating levers of the clocks may readily be moved so that they run on sidereal time.

PAUL B. SWEGER
R. R. No. 3, Box 29
Rockford, Ill.

VIENNA OBSERVATORY NEEDS A TELESCOPE

From Dr. Karl Wolf, president of the Vienna "Urania," a request has come via UNESCO for aid in restoring the public observatory. Dr. Wolf writes that the dome and 20-centimeter Zeiss refractor were destroyed during the war. The dome will be rebuilt, but a telescope of similar size (about an 8-inch refractor) must be procured with outside help. It is probable that arrangements can be made for UNESCO to defray the costs of packing and transport, if required. Communications may be addressed directly to Dr. Karl Wolf, Uraniastrasse 1, Vienna 1, Austria.

OBSERVER'S PAGE

Universal time is used unless otherwise noted.

Pinhole Images of Sunspots

Everyone is familiar, either by experience or from reading, with the little crescents produced in the shade of a tree during a partial eclipse of the sun. The interlacing leaves form numerous pinholes which produce in turn the pinhole images of the partially eclipsed sun. If one is alert, these images may be seen at any time when the sun is shining, except that they appear as circles and are not so spectacular as during a partial eclipse.

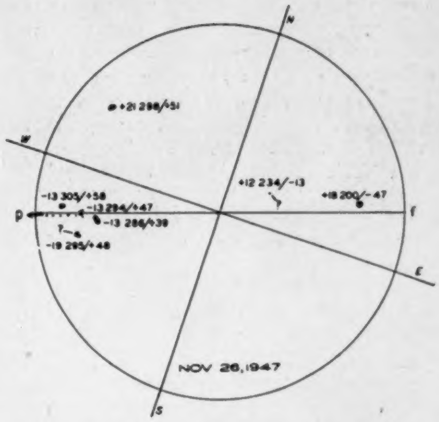
Some years ago an amateur who was also a poultry farmer noticed that he was obtaining fine pinhole images of the sun in one of his fowl houses. Whether this and subsequent actions had any effect on egg production is not known, but, being a good astronomer, he studied the image and found that he could see one or two sunspots. These he observed with care and subsequently sent his drawings to me. From such measurements as could be made, there was no doubt that he had indeed observed sunspots, and that his plotted positions were as accurate as could be expected.

Recently another case has come to my notice, and is perhaps on a grander scale. R. B. Orton, a member of the Royal Astronomical Society of New Zealand and an honorary assistant at the Carter Observatory, while working in a wool store building, noticed that a small hole, not greater than a quarter of an inch in diameter, in a roof ventilator, was causing a fairly large pinhole image of the sun about 40 feet away. The large room was dark, and not only was he able to see the solar disk but also what he took to be sunspots. I then asked him to try to obtain careful drawings on six-inch disks with a preceding-following line. This he did on November 24, 25, and 26, 1947.

The making of the drawings was a little difficult and required some skill, as the image traveled very rapidly. However, he managed to obtain the required results, which were then compared with telescope observations made at the Carter Observatory.

Perhaps the first surprising thing was the number of small spots which had been detected. Naturally they were fuzzy in outline in the pinhole image, and a group of pores was likely to appear as a single hazy spot, but the fact that they could be seen was of some interest.

The smallest spot which he observed was on November 26th, not much more than a large pore in position −26 296/+50. This method of stating sunspot positions is in use at the Carter Observatory. The first two numbers, with the sign, give the latitude, the next three the solar longitude, and the two after the stroke the distance from the central meridian, + for west and − for east. Perhaps



A reproduction in ink of a drawing by Mr. Orton of the sun on November 26, 1947. The direction of diurnal motion (drift of the image) is horizontal.

he recognized this small spot, and not others, because its proximity to a large group drew his eye to it. The roughly measured position from his drawing was −19 295/+48.

A small spot seen on the 25th and 26th could not have had an angular dimension of much more than 14 seconds, although it "fuzzed out" to probably more than this in his view. His positions for this spot were +14 201/−59 for the 25th and +18 200/−47 for the 26th. Other larger spots visible on these days were recorded, but the difficulties of observation caused the measured positions to vary by any amount up to five degrees. On the whole, however, Mr. Orton performed a very good piece of work.

Apart from the interest in the observations themselves, they lead us to speculate on how far our knowledge of the sun would have advanced had telescopes never been discovered. Pinhole images would probably have revealed such facts as these:

1. Spots occur on the solar disk.
2. The movement of spots across the disk.
3. The time of rotation of the sun.
4. Roughly the position of the solar axis.
5. The fact that spots are not permanent features.
6. The cycle of solar activity.

In fact, the more we consider it, the more it becomes obvious that without telescopes it would have been possible to obtain some fundamental knowledge concerning the sun.

I. L. THOMSEN
Carter Observatory
Wellington, New Zealand

UNIVERSAL TIME (UT)

TIMES used on the Observer's Page are Greenwich civil or Universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the UT before subtracting, and the result is your standard time on the day preceding the Greenwich date shown.

SKY-GAZERS EXCHANGE

Classified advertisements for this column are 8 cents a word, including address; minimum ad 20 words. Remittance must accompany orders. Write Ad Dept., Sky and Telescope, Harvard Observatory, Cambridge 38, Mass.

OCCULTATION PREDICTIONS

December 8-9 **351 B Aquarii** 6.5, 23:32.9 −7-45.1, 8, Im: **A** 23:00.0 ... ... 137; **B** 22:44.9 ... ... 112; **C** 22:38.3 ... ... 124; **D** 22:27.1 −2.8 +0.4 101; **E** 21:56.9 −1.9 +1.3 87.

9-10 **10 Ceti** 6.4, 0:23.9 −0-20.2, 9, Im: **E** 5:28.2 −0.6 −0.2 57; **F** 5:27.3 −1.3 −1.1 88; **G** 5:32.3 ... ... 344; **H** 4:58.1 −1.1 +1.4 35.

10-11 **e Piscium** 5.7, 1:05.7 +5-22.5, 10, Im: **A** 5:33.0 ... ... 349; **C** 5:19.6 −0.4 +2.2 11; **E** 5:19.3 ... ... 350; **F** 4:47.9 −1.1 +1.9 29.

12-13 **29 Arietis** 6.1, 2:30.0 +14-48.3, 12, Im: **A** 23:21.5 −0.8 +2.1 46; **B** 23:27.1 −0.7 +2.2 40; **C** 23:10.5 −0.7 +2.1 45; **D** 23:19.8 −0.4 +2.3 33; **E** 23:08.8 0.0 +2.5 21; **F** 22:45.6 +0.1 +2.2 30.

13-14 **14 H^1 Tauri** 6.4, 3:36.0 +20-44.9, 13, Im: **B** 8:46.5 +0.4 −3.0 130; **G** 8:12.5 −1.3 −4.2 131; **I** 8:03.9 ... ... 136.

17-18 **c Geminorum** 5.4, 7:40.9 +25-54.6, 17, Em: **A** 11:04.5 −0.6 −1.4 275; **B** 10:59.7 −0.5 −1.5 280; **C** 11:05.3 −1.0 −0.9 260; **D** 10:58.1 −0.9 −1.2 268; **E** 10:43.4 −2.3 +0.6 236; **G** 10:03.3 −1.8 +0.9 245; **I** 9:44.5 −1.9 +2.4 231.

For selected occultations visible at standard stations in the United States and Canada under fairly favorable conditions, these predictions give: evening-morning date, star name, magnitude, right ascension in hours and minutes and declination in degrees and minutes, moon's age in days, immersion or emersion; standard station designation, UT, **a** and **b** quantities in minutes, position angle; the same data for each standard station westward.

Longitudes and latitudes of standard stations are:

A +72°.5, +42°.5 E +91°.0, +40°.0
B +73°.6, +45°.6 F +98°.0, +30°.0
C +77°.1, +38°.9 G +114°.0, +50°.9
D +79°.4, +43°.7 H +120°.0, +36°.0
I +123°.1, +49°.5

The **a** and **b** quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude respectively, enabling computation of fairly accurate times for one's local station (long. **Lo**, lat. **L**) within 200 or 300 miles of a standard station (long. **LoS**, lat. **LS**). Multiply **a** by the difference in longitude (**Lo — LoS**), and multiply **b** by the difference in latitude (**L — LS**), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Universal time to your own standard time.

METEORS IN DECEMBER

The richest of the autumn showers may be observed this month. The Geminid meteors are at maximum from December 11th to 13th, and meteors in lesser numbers may be expected a week before and after. A gibbous moon in Aries at maximum will decrease the rates and interfere with seeing fainter meteors. Many bright and trained meteors are associated with the Geminids. Rates from 20 to 30 or more per hour are common under favorable conditions. The radiant is near Castor, and best observations of this shower are obtained before midnight.

MINIMA OF ALGOL

December 2, 3:24; 5, 0:13; 7, 21:02; 10, 17:51; 13, 14:41; 16, 11:30; 19, 8:19; 22, 5:09; 25, 1:58; 27, 22:47; 30, 19:37.

These predictions are geocentric (corrected for the equation of light), based on observations made in 1947. See **Sky and Telescope**, Vol. VII, page 260, August, 1948, for further explanation.

Planetarium Notes

ADLER PLANETARIUM

900 E. Achsah Bond Drive, Chicago 5, Ill. Wabash 1428

SCHEDULE: Mondays through Saturdays, 11 a.m. and 3 p.m.; Sundays, 2:30 and 3:30 p.m.

STAFF: *Director,* Wagner Schlesinger. *Other lecturers:* Harry S. Everett, Albert B. Shatzel.

BUHL PLANETARIUM

Federal and West Ohio Sts., Pittsburgh 12, Pa. Fairfax 4300

SCHEDULE: Mondays through Saturdays, 2:15 and 8:30 p.m.; Sundays and holidays, 2:15, 3:15, and 8:30 p.m.

STAFF: *Director,* Arthur L. Draper. *Other lecturers:* Nicholas E. Wagman, J. Frederick Kunze.

December: STAR OF BETHLEHEM. A production which turns back the pages of history to explore the scientific possibilities for that most famous of all stars, the Star of Bethlehem.

January: THE SOUTHERN CROSS.

FELS PLANETARIUM

20th St. at Benjamin Franklin Parkway, Philadelphia 3, Pa., Locust 4-3600

SCHEDULE: 3 and 8:30 p.m. daily except Mondays; also 2 p.m. on Saturdays, Sundays, and holidays. 11 a.m. Saturdays, Children's Hour (adults admitted).

STAFF: *Director,* Roy K. Marshall. *Other lecturers:* I. M. Levitt, William L. Fisher, Armand N. Spitz, Robert W. Neathery.

December: STAR OF BETHLEHEM. The story of the Christmas star will be presented with music in keeping with the season.

GRIFFITH PLANETARIUM

P. O. Box 9787, Los Feliz Station, Los Angeles 27, Calif., Olympia 1191

SCHEDULE: Wednesday and Thursday at 8:30 p.m. Friday, Saturday, and Sunday at 3 and 8:30 p.m. Extra show on Sunday at 4:15 p.m.

STAFF: *Director,* Dinsmore Alter. *Other lecturers:* C. H. Cleminshaw, George W. Bunton.

December: THE CHRISTMAS STAR. The sky will be shown as at the beginning of the Christian era, with all known objects in their proper relative positions.

January: THE WINTER SKY.

HAYDEN PLANETARIUM

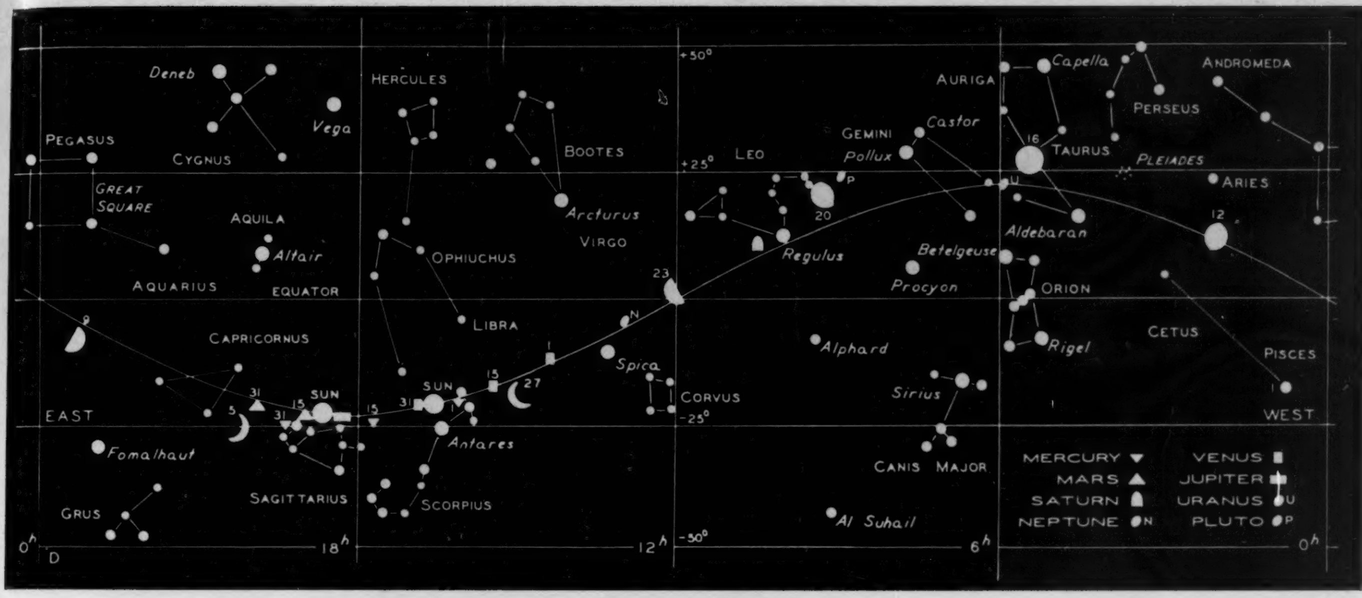
81st St. and Central Park West, New York 24, N. Y., Endicott 2-8500

SCHEDULE: Mondays through Fridays, 2, 3:30, and 8:30 p.m.; Saturdays, 11 a.m., 2, 3, 4, 5, and 8:30 p.m.; Sundays and holidays, 2, 3, 4, 5, and 8:30 p.m.

STAFF: *Honorary Curator,* Clyde Fisher. *Chairman and Curator,* Gordon A. Atwater. *Other lecturers:* Robert R. Coles, Catharine E. Barry, Shirley I. Gale, Kenneth J. Heuer, William R. McDonald, Eugene L. Benedict, Frank H. Schleifer, Clarence V. Lee.

December: THE STAR OF BETHLEHEM. In this Christmas sky drama we turn the heavens back to the time of the first Christmas to discuss the star the Wise Men followed nearly 2,000 years ago.

January: THE SKY PAGEANT OF 1949.



THE SUN, MOON, AND PLANETS THIS MONTH

The sun, on the ecliptic, is shown for the beginning and end of the month. The moon's symbols give its phase roughly, with the date marked alongside. Each planet is located for the middle of the month and for other dates shown.

Mercury moves from the morning into the evening sky on December 12th, superior conjunction with the sun occurring on that day. The planet may not be viewed until January.

Venus remains brilliant in the morning sky, nearly a magnitude fainter than during the past summer. In December, the planet crosses Libra, through part of Scorpius and into Ophiuchus. On the 23rd, Venus will appear to pass between Beta and Nu Scorpii.

Earth will reach heliocentric longitude 90° on December 21st, at 22:34 UT. Winter commences in the Northern Hemisphere and summer in the Southern.

Mars, setting about 1½ hours after the sun throughout the month, will no longer be visible. With the aid of a telescope, however, Mars may be found on the 1st of December 1° south of Jupiter, and three magnitudes fainter.

Jupiter, approaching conjunction on January 1st, will not be visible in the evening sky after early December.

Saturn, the only bright planet visible at midnight, rises about five hours after sunset. Saturn is stationary in right ascension on the 17th before assuming retrograde motion, and hence appears virtually without motion all month, 6° east of Regulus in Leo.

Uranus comes to opposition with the sun on December 20th, and may be found all night. The Herschelian planet, of +5.8 magnitude, is west of 1 Geminorum, nearly on the ecliptic and moving westward.

Neptune, rising about 1 a.m. local time, is in Virgo, about 2½° west of Theta. Of the 8th magnitude, it is visible only in a telescope. On the 24th at 4:41, a close conjunction of Neptune and the last-quarter moon occurs, the planet being 2′ south.

E. O.

NORTHERN LIGHTS IN INDIANA

On the night of October 1-2, we had a very unusual display of northern lights here at Goshen. The show reached a climax at midnight when the northern horizon from east to west was covered with a soft green crepe, and crimson rays shot nearly to the zenith. Everyone was impressed with the rapid action and movement, and soon the display died away to a large S curve in the east.

About 20 minutes later bright white streamers appeared and soon passed overhead. They went south of Alpha Pegasi, or about 50 degrees from the southern horizon. The entire northern half of the sky was filled with flashing, shimmering lights. Frequently ripples passed through large sections.

This display was first noted shortly before 11:00 p.m., when three or four faint white rays appeared. It was undoubtedly associated with the large sunspot which passed the central region of the sun earlier that same day.

OWEN GINGERICH
1613 S. 8th St., Goshen, Ind.

VARIABLE STAR MAXIMA

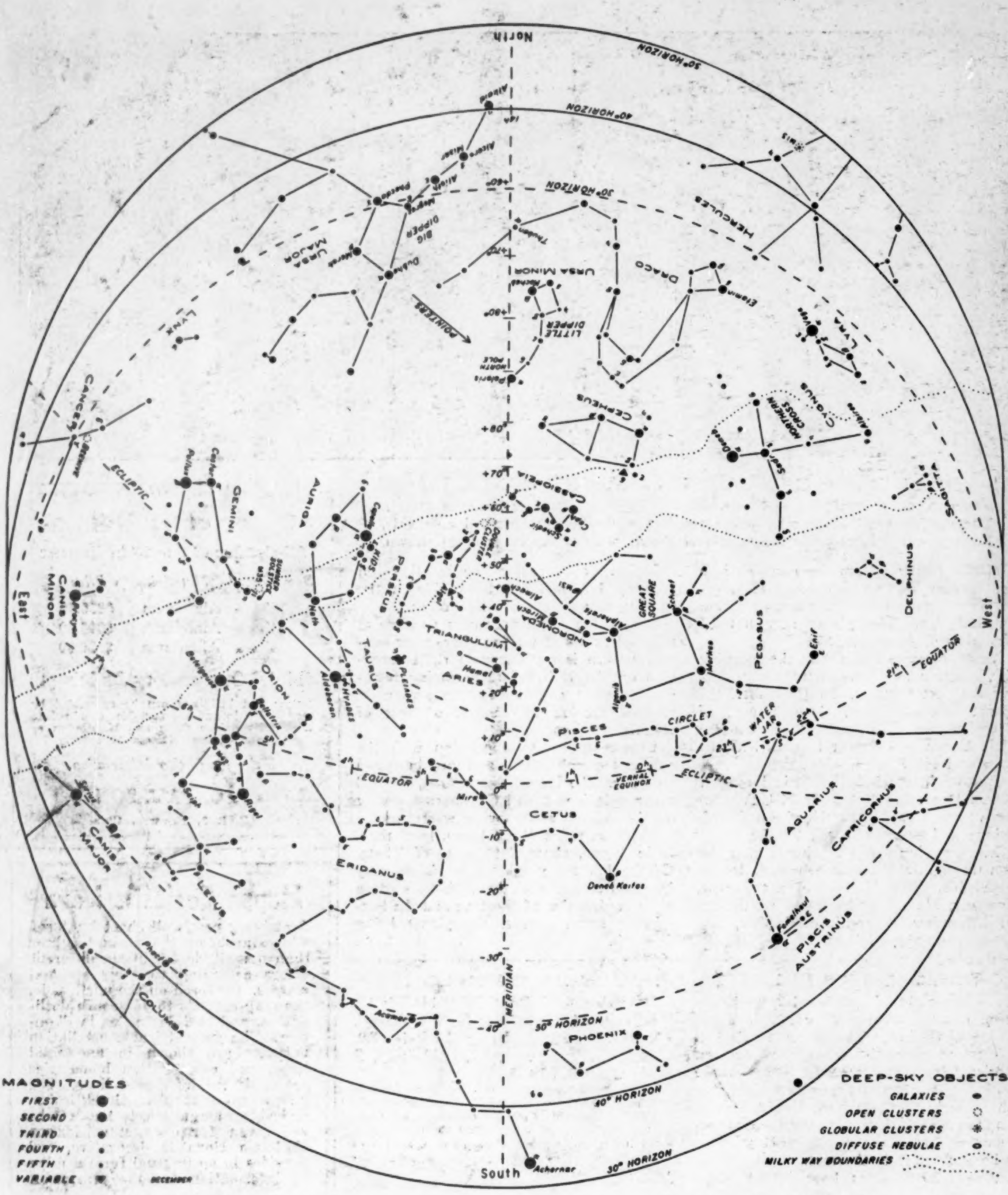
December 8, R Bootis, 7.3, 143227; 13, RT Sagittarii, 7.9, 201**139**; 14, V Ophiuchi, 7.5, 162**112**; 20, S Ursae Majoris, 7.9, 123961; 25, T Hydrae, 7.7, 085**008**; 29, S Sculptoris, 6.8, 001**032**.

These predictions of variable star maxima are made by Leon Campbell, recorder of the AAVSO, Harvard College Observatory, Cambridge 38, Mass. Serious-minded observers interested in making regular telescopic observations of variable stars may write to Mr. Campbell for further information.

Only stars are included here whose mean maximum magnitudes, as recently deduced from a discussion of nearly 400 long-period variables, are brighter than magnitude 8.0. Some of these stars, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).

PHASES OF THE MOON

First quarter	December 8,	13:57
Full moon	December 16,	9:11
Last quarter	December 23,	5:12
New moon	December 30,	9:44



The sky as seen from latitudes 30° to 50° north, at 9 p.m., and 8 p.m., local time, on the 7th and 23rd of December, respectively.

DEEP-SKY WONDERS

SEVERAL AMATEURS have written this page asking for information on complete lists of nebulae and clusters. Sadly enough there are none. The amateur must collect a half dozen books, some out of print and rare, before he can have even a partial list.

For external galaxies brighter photographically than magnitude 13: Harvard **Annals, 88**, 2, 1932, gives 1950 positions, photographic magnitudes, diameters, types. For globular and galactic clusters: Shapley's **Star Clusters** (out of print and rare), where he gives a catalogue of each, listing a great deal of information. The same material is included in Volume 6 of the **Handbuch der Astrophysik**, very rare.

A detailed list with photographs for the planetary nebulae is in **Publications** of the Lick Observatory, XIII, Part 3 ($5.00). Part 1 has a description of 762 nebulae and clusters; Part 2, some data on occulting matter in spirals. The **New General Catalogue** (NGC) with its two Index catalogues is long out of print and almost impossible to obtain. Furthermore, its objects are not classified so it is of limited use to the amateur.

To add to the confusion, Norton's **Atlas** uses three distinct systems of identification, and while lists exist for changing the Herschel numbers to NGC and back again, they are not available to the average amateur. This column is using photostats of such tables from a German book.

WALTER SCOTT HOUSTON

EVENING STARS FOR SOUTHERN OBSERVERS

THIS CHART is prepared for a basic latitude of 30° south but it may be used conveniently by observers 20 degrees on either side of that parallel. These southern charts appear in alternate months, but always two or three months in advance to allow time for transmission to observers in any part of the world. The sky is here shown as it appears on Feb. 7th at 11 p.m., Feb. 23rd at 10 p.m., March 7th and 23rd at 9 p.m. and 8 p.m., respectively. Times for other days vary similarly, four minutes earlier per day. These are local mean times which must be corrected for standard time differences. The 30° horizon is a solid circle; the other horizons are circles, too, those for 20° and 40° south being dashed in part. When facing south, hold "South" at the bottom, and similarly for other directions. Observers in the tropics may find north circumpolar stars on any of our northern star charts. For other charts in this series, see alternate issues, February, 1947, to August, 1947; November, 1947, to September, 1948; and October, 1948.